ABSTRACT

Title of Dissertation:	DESIGN, IMPLEMENTATION, AND EVALUATION OF A MINDFULNESS FOCUSED NUTRITION PROMOTION PROGRAM TO BALANCE USDA SCHOOL NUTRITION GOALS WITH FOOD WASTE REDUCTION IN ELEMENTARY SCHOOLS
	Amy E. Schachtner-Appel, Doctor of Philosophy, 2019
Dissertation directed by:	Associate Professor Hee-Jung Song, Department of Nutrition and Food Science

Healthy school meals offer numerous benefits for elementary school students, but low produce intake and high rates of waste prevent students from experiencing these benefits. This research aimed to create a mindful and sustainable eating intervention to encourage reduced waste and increased produce intake during lunch. The study was conducted using a mixed-methods triangulation approach for formative research, creation of a behavioral model to design a theory based intervention, and pilot test of the resulting program using a quasi-experimental controlled design.

Formative findings, gathered from 50 3rd-5th grade focus group participants, 15 in-depth interviews with school staff, and 9 cafeteria observations supported the use of social cognitive theory (SCT) to explain eating behaviors and emphasized the importance of involving student leaders and creating environmental reinforcements. Pilot

intervention approaches included delivery of an education curriculum, dissemination of messages by student leaders, cafeteria environment changes, and creation of a food recovery program. Measurements included observation of kindergarten – 5th grade lunches at baseline and follow-up (n = 162) to estimate foods selected, consumed, and wasted, survey of 3rd – 5th grade students at baseline and follow-up (n = 169) to measure psychosocial changes related to mindful and sustainable eating, and periodic food waste audits (n = 8) to monitor school-level plate waste.

Baseline results showed students consumed only 36-42% of vegetables selected and 64-67% of fruit selected. At follow-up, intervention students selected more produce than controls (1.09 vs. 0.64 servings of vegetables; 1.32 vs. 1.06 servings of fruit). Similarly, they consumed more produce (0.51 vs. 0.33 servings of vegetables; 0.94 vs. 0.70 servings of fruit) than controls. Intervention students trended toward reduced vegetable waste while maintaining selection, whereas controls decreased selection substantially. Intervention students experienced significant increase in self-efficacy to base lunch choices on body cues. Higher produce consumption and lower waste were predicted by improved intentions to eat healthfully.

Overall, the program successfully improved intake and trends indicate potential to reduce waste. Findings support expansion of the program, with potential to improve nutritional status of students and reduce the environmental impact of school meals.

DESIGN, IMPLEMENTATION, AND EVALUATION OF A MINDFULNESS FOCUSED NUTRITION PROMOTION PROGRAM TO BALANCE USDA SCHOOL NUTRITION GOALS WITH FOOD WASTE REDUCTION IN ELEMENTARY SCHOOLS

by

Amy E. Schachtner-Appel

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2019

Advisory Committee:
Associate Professor Hee-Jung Song, Chair
Associate Professor Jie Chen
Dr. Joanne Guthrie
Professor Nadine Sahyoun
Professor Christopher Walsh

Dedication

To my dad – your loving wisdom and secret silliness make this world feel understandable. Thank you for teaching me to be curious. I still don't believe that turkeys drown in the rain.

Acknowledgements

This research is the product of tremendous guidance and assistance from so many people and its completion would never have been possible without each of you. I am incredibly grateful for the time, effort, generosity, and oversight. Thank you to my committee – your knowledgeable feedback has been amazingly helpful – and specifically to my advisor. Dr. Song, it has been a pleasure to be your student over the past five years. I truly appreciate the latitude you allowed me in finding the direction for this work, while sharing your wisdom and experience to ensure the project moved in a productive direction. To the many others helped me build relationships, find study sites, and understand the available resources – in particular, Sara Booker, Chrissa Carlson, and Ashley MacLaughlin – thank you for offering your time and the benefit of your community connections. And to the many data collectors and research assistants who helped with this project – your dedication and energy were absolutely essential to its completion. You were all a joy to work with.

To everyone in Caroline County – you are among the kindest and most generous people I have ever met. I truly appreciate your flexibility and allowing me to work in your schools. Beth Brewster, it was your vision that first shaped this project and I hope to be lucky enough to work with you again. Faye, Mary, and all of the cafeteria and custodial staff – I am so grateful for your understanding when we created chaos in your lunchrooms and for giving us an opportunity to find our footing. To the administrators and teachers, thank you for giving me the opportunity to work with your students. And to the students who participated throughout this project – you were the center of all of this, and I hope this project was as fun for you as it was for me. If you learned half as much as I did while we worked together, we were successful.

And perhaps most importantly, thank you to my husband, Alex – your support and patience mean more to me than you know.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

DGA – Dietary Guidelines for Americans

EPA – Environmental Protection Agency

FAO – Food and Agriculture Association (of the United Nations)

FARM – Free and Reduced-Price Meals

FTTF – *Farm to Tray, Tray to Farm*

HHFK – Healthy, Hunger-Free Kids Act

ICC – Intraclass correlation coefficient

MD – Maryland

NSLP – National School Lunch Program

OR – Odds ratio

OVS – Offer versus Serve

RE-AIM – Reach, Effectiveness, Adoption, Implementation, and Maintenance

SCT – Social Cognitive Theory

SL – Smarter Lunchrooms

UK – United Kingdom

US – United States

USDA – United States Department of Agriculture

CHAPTER 1: INTRODUCTION

1.1 Problem Statement & Rationale

While meals served through the National School Lunch Program (NSLP) aim to improve nutritional status and reduce food insecurity among the nation's schoolchildren, rates of plate waste in these programs is estimated to be as high as 31% of foods served, with the highest rates of waste seen among vegetables and fruit. High waste of healthy foods, an extensive body of literature that documents low acceptance of these foods among children, and high burden from diseases that are related to poor diet show a need to improve intake among school children to improve their health and decrease risk of negative health outcomes.

Simultaneously, food waste, including the portion that is a direct result of eating behaviors (i.e. plate waste), poses an important environmental and economic threat. Food production comprises a substantial portion of the United States (US) and global economies and is highly resource intensive. Nearly one third of all edible food is wasted globally, resulting in overburdening of landfills, unnecessary use of finite resources, and excessive production of greenhouse gases. As NSLP serves 30 million children daily, habits observed in school meals mimic those of the general population and targeting waste reduction efforts at school meal programs would have far-reaching benefits.

This research presents the findings of a study that aims to address goals of improving dietary intake of school children and reducing plate waste produced in NSLP.

This study examined the appropriateness of approaches that emphasize the development of mindful and sustainable behaviors among elementary school children during a formative study. Based on those findings, the researcher designed a school-based nutrition promotion program built from SCT, and evaluated the impact of this program in increasing intake of fresh produce and reducing plate waste generated by elementary school students during lunch.

1.2 Research Objectives

The overall objective of this study was to reduce plate waste and increase fruit and vegetable intake among elementary school students participating in NSLP meals. In order to achieve this objective, the study had three primary aims:

1) To conduct formative research to examine key determinants of plate waste and identify opportunities for nutrition promotion and education in elementary school settings

The purpose of the first aim was to more fully understand the psychosocial factors that underlie plate waste behaviors, student interest and knowledge about related topics, and logistical considerations when implementing a nutrition promotion program in elementary school settings. This was addressed through a variety of formative activities, including focus groups with students, interviews with school staff, and cafeteria observations. Specifically, previous research pointed to an opportunity to incorporate mindful eating, emphasize environmental sustainability, and utilize student leaders. These strategies and the general appropriateness of the SCT were examined to develop a

behavioral model to explain mindful and sustainable eating behaviors of elementary school students that would serve as the basis for the nutrition promotion intervention.

2) To design a school-based nutrition promotion program rooted in SCT that targets the behavioral model to explain mindful and sustainable eating behaviors of elementary school students

Formative findings and the resulting behavioral model were used to design a multicomponent, theoretically based intervention to target identified constructs leading to mindful and sustainable eating behaviors. The program utilized evidence-based strategies and selected components from previously tested curricula developed by accomplished educators experienced in the fields of mindfulness and the food system to create a pilot program that targets personal, behavioral, and environmental constructs related to elementary school student eating behaviors.

3) To evaluate the efficacy of the program in increasing fruit and vegetable intake and reducing plate waste among elementary school students who participate in NSLP

A pilot intervention, called *Farm to Tray, Tray to Farm* (*FTTF*) was developed with primary goals to reduce plate waste and increase fruit and vegetable intake at lunch by encouraging elementary school children to develop mindful and sustainable eating behaviors. The program utilized a 16-week education and skill-based curriculum for student leaders, dissemination activities planned and implemented by those same student leaders, changes to the cafeteria environment, and creation of a food recovery program in the cafeteria to achieve this aim. Key outcomes in the study, measured among elementary

school students, were produce and energy content of foods selected, consumed, and wasted at lunch and changes in psychosocial constructs related to mindful and sustainable eating behaviors.

1.3 Project Overview

The research in this dissertation describes work to design, implement, and evaluate a nutrition promotion program that aimed to reduce plate waste and increase fruit and vegetable intake among elementary school students at lunch. The formative study identified important psychosocial constructs that are related to student eating behaviors and results supported the use of mindfulness- and sustainability-focused strategies oriented around SCT to encourage students to develop skills and behaviors that enable them to consume more fruits and vegetables and create less waste at lunch.

Following the formative study, the *FTTF* program was implemented in two Maryland elementary schools (one as the intervention site and the second as a control) using a quasi-experimental controlled design and four main approaches: delivery of an education curriculum, dissemination of study messages by student leaders, cafeteria environment changes, and food recovery. Outcomes were measured at baseline and follow-up, and evaluated changes among students in the amount of produce they selected, consumed, and wasted at lunch and psychosocial factors related to mindful and sustainable eating.

Specifically, the program utilized the efforts of a group of student leaders as a key strategy; these students directly received a 16-week education program and were responsible for creating and delivering methods to disseminate messages to their school.

Combined with other strategies, including the creation of a food recovery program (that diverted unopened items from the trash and offered a mechanism to address food insecurity in their community) and cafeteria-based strategies (to highlight daily produce choices, emphasize students' autonomy in selecting their food, educate students on the environmental implications of waste, and engage them in the program), *FTTF* was a multicomponent intervention that intended to empower students to make healthier, more responsible decisions.

Results of the pilot implementation of *FTTF* were largely encouraging. Students who received the intervention had increased selection and consumption of fruit and had positive trends with respect to vegetable intake and plate waste patterns. Similarly, several positive changes in self-efficacy to eat mindfully and identified relationships between intentions and produce consumption and waste were noted. Further, the intervention was feasible and well-accepted.

CHAPTER 2: LITERATURE REVIEW

2.1 USDA School Meals Goals and Objectives

The overarching goal of the National School Lunch Program (NSLP) is to provide students with access to balanced meals, at free or reduced price for low-income populations.[1–3] Over 30 million students are served daily through NSLP,[3] providing an efficient venue where a large proportion of the nation's school children can be reached by interventions intended to complement the United States Department of Agriculture's (USDA) services. There are numerous benefits associated with school meals in addition to the actual nutrients consumed by students. School meals support healthful physical, emotional, and educational development, along with the overall well-being of students.[4–6] Additionally, school nutrition programs provide a supportive venue for students to develop healthy eating habits; such habits developed in childhood tend to follow individuals into adulthood and may support health throughout the lifespan.[7] When the nutritional content of school meals are compared to home prepared lunches, it appears that students who participate in NSLP have higher diet quality than non-participants, both when only their lunches and when their entire intake over a 24-hour period were compared.[3] Nevertheless, it has been routinely observed that fruits, vegetables, and other nutrient dense foods are among those wasted most often; because of this waste pattern, many important micronutrients that are served to children go uneaten. High rates of plate waste in school nutrition programs threatens the ability of school meals to achieve important child nutrition goals and support the healthy development of children.

2.1.1 Current Approaches to Support Improved Nutrition in USDA School Meals

New standards introduced in 2010 through the Healthy, Hunger-Free Kids Act (HHFK) and implemented in schools in 2012 focused on aligning school meals with the 2010 Dietary Guidelines for Americans (DGA).[1–3] The new meal standards dramatically improved the nutritional content of school meals, by emphasizing increased consumption of fruits, vegetables, whole grains, and low-fat dairy; limiting sodium; creating age-specific serving sizes; and introducing nutrition standards for competitive and a la carte foods.[1,3]

Other strategies adopted by the USDA to promote healthy eating in NSLP include offering support for schools to incorporate Smarter Lunchrooms (SL) techniques. Specifically through programs such as Team Nutrition grants, the HealthierUS Schools Challenge, and Team up for Success, the USDA provided funding, certifications, and training for school food service programs to incorporate strategies to create a cafeteria environment that encourages healthy eating.[8,9] The SL movement has resulted in a set of research-based recommendations that encourage students to make healthier choices, often by altering the cafeteria environment to make healthy foods more available and through marketing techniques that nudge students to selecting and consuming those foods.[10–12] Implementing SL techniques in schools has been shown to promote the selection and consumption of fruits and vegetables, improve student satisfaction, and increase participation with NSLP.[10,11,13,14]

2.1.2 Current Approaches to Food Waste Reduction in USDA School Meals

The USDA has incorporated several strategies into school meals policies that increase flexibility and encourage the reduction of waste. Offer Versus Serve (OVS), a provision that is mandatory in high schools and optional in elementary and middle schools, is a practice where students select at least 3 of 5 food group components offered, one of which must be a fruit or vegetable, when purchasing a reimbursable meal.[2] Use of OVS is associated with reduced plate waste in schools,[3] and it is logical to consider that some of the observed reduction in waste is an outcome of not requiring students to take foods that they do not want to eat. Additional research supports the idea that increasing students' autonomy in their food selection and offering more choices can increase their acceptance of foods served at school as a result.[15]

Updated nutrition standards encourage schools to use a food-based approach to menu planning rather than a nutrient standard-based approach, where menus were planned based on the actual foods and food groups served instead of on overall nutrient content.[2] Proponents of a food-based approach suggest that it simplifies menu planning and increases opportunities for school food service programs to incorporate healthy foods that are acceptable by students;[2] such flexibility in menu planning is a helpful strategy for schools to plan menus that minimize waste.[15] New standards also created age-based nutrition goals, resulting in meal patterns that are consistent with the DGA and better enables programs to match their student population's needs.[2,15]

2.2 Food System Overview

The food system is a series of activities that transform raw resources into consumable food; such activities occur within a complex system of societal and biological influences.[16,17] Steps in the food system can be thought of as linear and include: production, processing, distribution, acquisition, preparation, and consumption.[17] To underscore its linkage with public health, some researchers discuss additional steps in the process – digestion, transportation, and utilization of nutrients – and thereby broaden the system to consider the transformation of raw materials to health outcomes.[16,18]

Natural and human resources (including land, water, energy, labor, and money) are used throughout each step of the system.[17] Depletion of these finite resources, all of which are related to the food people eat and how that food is produced, impact health, social/cultural, political, agricultural, and economic systems, among others.[17] Fundamentally, as explained by Sobal, et al.,[16] "a scarcity of inputs can limit the ability of the system to function."

For these reasons, researchers argue for the need to promote sustainability of the food system and to consider the food system as inseparably linked to public health. Sustainable food systems are those that provide healthy food that is sufficient to meet needs in ways that are affordable, humane, and just without causing harm to the environment.[17] Emphasizing the synergy between food systems and public health can lead to an integrated healthy and sustainable system of food production, which is necessary to address fundamental causes leading to public health concerns.[18] Because of the complexity of the system and the interrelatedness of various components, solutions that address food system or health problems must be multifactorial and far reaching in

response.[18] Food waste is one such problem, with complex causes that necessitate similarly complex solutions.

2.3 Food Waste Overview

The term 'food loss' is typically used to describe waste that occurs in early stages of the supply chain (i.e. in harvesting or production), while the broader term 'food waste' frequently applies to any food item that is fit for consumption but is discarded. Throughout this document, the term 'food waste' will be used to describe any edible food item that is not consumed, and the level of loss (i.e. consumer, retail, manufacturing, etc.) will be specified as appropriate. 'Plate waste' is used to describe edible food served to a consumer that they directly discard.

The estimated amount of edible food wasted is staggering. In the US, food waste is estimated to be 31% of the available food supply (133 billion pounds per year), representing approximately 1250-1400 kcal/person/day or $162-$198 billion annually.[19,20] Levels of food waste in the US have more than doubled since 1974, now equivalent to more than 300 million barrels of oil annually used in production.[21] It is hypothesized that food waste has increased as a result of increases in marketing and food availability.[21] Most food lost or wasted in the US occurs at retail and consumer levels, with meat, vegetables, fruit, and dairy representing the most frequently wasted food groups.[19,22] Calorie estimates of food waste alone may obscure the magnitude and impact of waste arising from nutrient-dense foods; because these are the foods wasted most often, food waste poses a threat to the nutritional status of individuals that is not sufficiently characterized by the available per capita calorie estimates.[23] The issues

surrounding food waste have important implications at both environmental and individual levels, and the impact varies based on setting. Fundamentally, researchers have stated that reducing food waste may improve food security, nutrition, budgets, environment, and public health.[22]

2.3.1 Environmental Implications of Food Waste

Food waste contributes to greenhouse gas emissions and lost resources, contributing to climate change, and threatening global food security,[20,24] and there is growing interest in studying it for several key reasons. Food waste represents a loss of financial, natural, and labor resources and comprises nearly 14% of solid waste sent to landfills.[19] The need to increase production for food that will ultimately be discarded has a negative impact on the environment by increasing pressures on water, land, and natural resources; examples include increased greenhouse gas emissions from cattle production, air pollution from transporting food, soil erosion and depletion due to growing practices, and methane production from landfill overburden.[19] Finally, it is fundamentally important that the planet has capacity to produce enough food to feed a growing population (estimated to exceed 9.3 billion by 2050).[25] If waste levels remain unchanged, this increase in population will necessitate a 70% increase in global food production, a level which may be impossible given the finite nature of natural resources and depletion of arable land.[19] Conversely, it is estimated that a 50% reduction in food waste in developed regions would decrease the number of undernourished people in the developing world by 63 million.[26]

Based on the important environmental and social impact of food waste, the Environmental Protection Agency (EPA) and USDA have set a goal to reduce food waste in the United States by 50% by 2030.[27] Waste reduction efforts can be categorized as focusing on preventing food waste primarily, recovering and redistributing excess food, and recycling excess food (by feeding animals, composting, or using food for industrial purposes).[28] An environmental and economic analysis of possible strategies to reduce waste indicates that, although efforts in all categories are important, prevention and recovery are more efficient than recycling.[28]

2.3.2 Implications of Food Waste at the Individual Level

Food waste has dramatic nutritional and financial implications at the individual level. Wasted food is estimated to comprise at least 9.2% of household food spending, which is a significant contribution, particularly for food insecure households.[22] Furthermore, although it is not known if food insecure households' per capita rate of food waste is higher or lower than the general population, overall food waste drives up food prices and disproportionately affects those with lower incomes.[19,22] Other researchers estimate that the average US family discards approximately $1,600 of edible food per year; savings of even a portion of that amount as a result of food waste reduction within the home could be extremely helpful in allowing those with limited resources to purchase foods that result in higher diet quality overall.[20] Additionally, there is a gap between requests for emergency food assistance and funding available to supply such programs; if a portion of foods that would otherwise be wasted were recovered and donated, they could help meet the nutritional needs of some of the most vulnerable Americans.[29]

Overall, it is estimated that the US population wastes 1,250-1,400 calories per day per person at the retail (460 calories) and consumer (789 calories) levels; the largest caloric contributors to these estimates are fats and oils, grains, and sugars/sweeteners.[19,20,23] By weight, the largest contributors to food waste are fruits and vegetables and this loss undoubtedly has negative dietary consequences.[22] Nutrient analysis estimates show that daily food waste at consumer and retail levels includes 5.9 g fiber, 1.7 μg Vitamin D, 286 g Calcium, and 880 g potassium; these nutrients are all among the "nutrients of public health concern" identified in the DGA.[23] The same study further estimated that the daily amount of edible food sent to landfills is enough to meet the calorie needs of 84% of the US population.[23] Interventions that successfully reduce waste of the most commonly discarded foods have the potential to dramatically improve the dietary intake of Americans, while simultaneously making available enough food to provide for those who are food insecure. Targeting consumer behaviors is a strategy that may also be an efficient way to effect change throughout the supply chain,[28] as changes in consumer behaviors could have upstream influence on previous steps; for example, retailers could be encouraged to take steps to mitigate waste in grocery stores as a response to increased customer awareness.

Consumers often cite expiration as a primary reason for food wastage, but it is known that lack of temperature control and cross-contamination are much larger drivers of food-borne illnesses than age of foods; this finding indicates that providing education on safe food handling and recognizing the signs of spoilage may be an effective strategy for reducing waste.[22] A barrier to food donation or recovery is concern over liability; for this reason, legal protections have been enacted where food donors cannot be held liable

as long as they have not acted with negligence or intentional misconduct.[30] While not all foods are suitable for donation, sealed items and produce with unpierced skin represent viable options with reasonable assurances of food safety.[29]

2.3.3 Estimates and Impact of Food Waste in Schools

While overall estimates of the magnitude and consequences of food waste are based on general population estimates, it is logical that the habits of a school-aged population and the resulting impact will differ in some ways from adults. Furthermore, as roughly 32 million students are served daily through school meals, waste behaviors in schools represent a large proportion of the habits of the total population.[31] In addition, school food programs are relied upon most heavily by low-income students, meaning that waste behaviors in schools may disproportionately affect the intake of those who are most vulnerable.[32] While NSLP regulations dictate that school meals provide adequate nutrition to support the health, growth, and learning of children, available data on actual nutrient consumption of children after adjusting for waste are somewhat limited. Additionally, it appears that participation in NSLP is correlated with lower consumption of empty calories at home, but it is not known if plate waste behaviors are an additional predictor of home intake.[7] For these reasons, it is necessary to examine the food waste practices that are specific to a school-aged population.

Overall, studies estimate levels of plate waste in US school meals at 12-43% of food served, depending on the student age and setting where data were gathered.[3,15,33,34] A recent, nationally-representative study of plate waste in NSLP showed rates as 31% of vegetables, 29% of milk, 26% of fruit and fruit juice, and 23% of grains served.[3] These

findings are in line with other estimates that show most waste resulting from vegetables, fruit, entrees, and milk.[33,34] Studies that evaluated the acceptability of new NSLP standards in 2010 found that students are consuming lower than recommended amounts of vitamin A, vitamin C, and iron and fewer than 85% of students are meeting the nutritional standards.[31,35,36] When the nutritional content of plate waste was examined, it appeared that students waste 21% of calories and at least 25% of key micronutrients, such as vitamin A, vitamin C, vitamin D, calcium, and potassium, that are served to them.[3] Rates of plate waste tend to be higher for elementary school students than for older students and higher when students have earlier lunch periods.[3]

A review of studies on plate waste in school nutrition programs estimated that wasted food represents an economic loss of approximately $600 million annually.[15] Similarly, a study by Cohen et al. examined nutrient losses and economic costs associated with school meal waste in middle schools.[32] The researchers calculated the costs associated with food waste and concluded that the equivalent of 26.1% of the total food budget was discarded by middle school students annually at lunch.[32] Food and labor each account for approximately 45% of a school nutrition program's costs.[3] Because both of these budgetary components are proportional to the amount of food served, it stands to reason that reducing plate waste, and in turn reducing the amount of excess food prepared, would result in a substantial savings to school food service operations.

2.3.4 Hypothesized Driving and Moderating Factors Affecting Food Waste

Recent studies have sought to assess reasons for food waste and motivating factors that may help reduce waste. In the general population, motivators to reduce waste

were to save money and to set an example for children. Environmental concerns were ranked last, indicating that there may be limited recognition of the environmental impact of food waste.[22] Importantly, the authors identified a gap between consumer perception of behavior and actual actions.[22] A qualitative study conducted in the United Kingdom (UK) sought to assess motivations and barriers to minimizing food waste through the use of semi-structured interviews.[37] The researchers highlighted a disconnect between recognition of societal and individual responsibility related to food waste; while respondents believed that the magnitude of food waste is a problem in the population, they downplayed how their personal food waste-related habits contributed to the identified problem.[37] Based on these findings, interventions should emphasize that reducing food waste has a moral basis and address issues such as denial of responsibility.[37]

Most research specific to a school-aged population cites student receptivity, low hunger levels at meal time, food preferences, limited time to eat, and meal palatability as primary drivers of plate waste.[15,31,32,34,36] Limited variety and choices available to students, like those available to students through the use of OVS or self-serve areas like salad bars, are also discussed as possible causes.[3,15,38] While these studies outline reasonable determinants of plate waste, most were primarily focused on documenting estimates of waste. Conversely, relatively little work has been done to empirically identify causes of plate waste in school settings.

One qualitative study was identified that sought to understand the underlying drivers of food waste in school meals through the use of focus groups and in-depth interviews of students, parents, teachers, cafeteria managers, and principals.[24] They

attributed food waste to three general factors: food-related (e.g. storage/inventory/food safety issues related to perishability and accessibility issues related to the time requirements or difficulty of consuming certainly foods, like oranges), child-related (specifically taste preferences and satiation), and program-related (i.e. insufficient time to eat, food service policies such as not utilizing OVS, and lack of coordination between administration and cafeteria staff regarding variations in attendance.)[24]

Zhao et al[38] conducted an interview-based study to understand barriers and motivating factors to plate waste reduction, from the perspective of adolescent students who participate with NSLP. In their analysis, poor food quality, foodservice policies (for example, not offering choice in food selection, not having enough time to eat, and not allowing leftover food to be saved or shared), low hunger, and social influences like peer distractions were commonly reported by students as barriers that would prevent them from reducing the amount of waste they produce.[38] Enabling more autonomy in selection, increasing the quality and variety of foods served, and allowing students to save or share food were cited by students as changes that would motivate them to minimize plate waste.[38] When asked about their perspectives about plate waste, students provided a variety of positive and negative opinions, though most of those quoted expressed ambivalence.[38] Based on these findings, it appears that students place little importance on the issue of food waste. No information was provided about any previous education that students may have received that would have informed them about the nutritional and environmental outcomes of plate waste, but based on their non-committal answers, it is reasonable to believe that, in general, school aged children have relatively little understanding about the issues related to plate waste or food waste in general.

Further examination of child-related issues is necessary to better understand factors related to plate waste produced by students who eat school meals. In addition to the drivers, motivators, and barriers, it would be beneficial for future work to investigate students' perceived importance of issues related to plate waste, as well as their background knowledge of and interest in learning more about such topics. Further work should also solicit perspectives on plate waste from adults within the school community, who can provide important information about feasibility and logistics. Such work will be helpful to identify potential strategies to reduce food waste behaviors in children.

2.4 Theoretical Background to Food Waste and Eating Behaviors in School Settings

A strong theoretical framework is necessary in designing effective behavior change interventions, as those that have a behavioral theory basis are more effective in attaining dietary behavior change than those that simply promote increased knowledge.[39] The framework should specify expected relationships among theoretically defined variables, be applicable to a specific population for a specific behavior, utilize consistency in implementation, and employ formal intervention planning procedures (such as intervention mapping or the use of logic models); further, the use of multiple theories is a tactic occasionally utilized when the desired behavior changes are complex.[39] It should be noted, however, that including constructs from various health behavior theories may lead to conceptual overlap in the constructs and redundancy in the model.[40,41] Rather, it appears useful to build a conceptual framework on one fundamental model, using additional relevant theories as background to identify possible determinants and mediators of behavior.[41,42]

SCT, originally developed by Albert Bandura, has been used frequently for the design of nutrition education programs and is well-suited for this area because of the theory's applicability to influencing behavior change in youth and improving public health.[39,43–45] SCT has also been used to design experiential or skill-based food system programs, including farm-to-school interventions.[46,47] The SCT explains behavior change as arising from three factors (the environment, personal/cognitive factors, and behavioral factors) and the reciprocal interplay between them.[43] Within these realms lie constructs, or unobservable variables that comprise the underlying mechanism of the behavior of interest; typical constructs in SCT include self-efficacy, intentions, situation, behavioral strategies, social support, outcome expectations, and outcome expectancies.[48] When investigating healthy eating behaviors of adolescents, Dewar et al[48] developed an instrument with demonstrated factorial validity to measure these SCT constructs, indicating that the SCT is a useful theoretical model to explain adolescent dietary behaviors. Additional research to identify psychosocial correlates of childhood and adolescent eating behaviors found that intention, knowledge, liking, modeling, and preferences were significantly related to fruit and vegetable consumption.[49] It further appears that social influences are important precursors to an adolescent's intention to choose healthy foods.[50]

Additional health behavior theories, including the Dual-Process Theory, Health Belief Model, Habit Strength Theory, Theory of Planned Behavior, and Transtheoretical Model, have also been used in youth-based dietary behavior change interventions.[51] A review of mediation analyses of these various theoretical frameworks showed the most evidence for self-efficacy/perceived control, outcome expectations/attitude, habits,

knowledge, social support, modeling/observational learning, availability of food, and subjective/group norms as predictive of dietary behavior; the identification of these constructs supports the use of SCT or the Theory of Planned Behavior when planning interventions for a child or adolescent audience.[51] Because of the conceptual overlap between the two identified theories and SCT's extensive use in planning programs aimed at changing dietary behaviors in youth, SCT can be considered an appropriate choice to form the theoretical foundation for a food waste reduction intervention. Results from programs that utilized the Theory of Planned Behavior are be useful in identifying additional behavioral influences and were considered when building the final conceptual framework.

2.5 Relevant Methodologies for the Study of School-Based Eating Behavior

Research of school-based eating habits is multifaceted, involving the application of several scientific disciplines, understanding of human behaviors, and implementation of educational models. For this reason, extensive methodological work must be done. In the present research, a formative study identified needs of the target school system. Possible effective strategies from nutrition, behavioral economics, education, psychology, and environmental sciences were identified and a curriculum was compiled to target identified needs. Finally, measurement techniques were selected, and specific tools and procedures required adaptation to fit the present intervention. The following section summarizes and provides research findings for the methods used.

2.5.1 Formative Methods Relevant to Understanding Behavioral Phenomena

Qualitative research is necessary to understand a specific phenomenon or behavior, along with contextual factors and relevant cultural, emotive, or perception-based considerations that give meaning to the phenomenon of interest.[52] Conducted during the formative stage of program design, qualitative methods allow researchers to tailor intervention strategies to the specific needs of their target population and to generate or validate theories that form the basis of a new program.[52] In proposing a hierarchy of qualitative methods, Daly et al[53] recommend designing studies based on a literature-derived conceptual framework when seeking to understand the perspectives of a relatively small group of participants. Such studies, which utilize methods such as interviews and focus groups, intend to produce an overall account of perspectives of those within the community while also serving to highlight divergent views.[53] This suggestion is relevant to community- and school-based interventions; because this work is participatory in nature, it is necessary to have both a broad, detailed understanding of beliefs of the population and awareness of unusual beliefs held by specific community members who have the potential to serve as champions or distractors, depending on their perspective. In this way, identifying possible opponents of a project offers an opportunity to convert those individuals into champions by addressing any misconceptions they may hold, emphasizing the importance of the project, and ensuring that they feel involved in project design.

Qualitative research is descriptive in nature and sensitive to bias, but the use of documented strategies ensure that such studies are high quality while minimizing issues related to validity. In order to develop a thorough understanding of a behavior about

which relatively little is known, like many of the complex eating behaviors of children, several techniques exist to lend credibility of qualitative findings. Incorporating methods of triangulation, by soliciting information from a variety of sources, is a technique to corroborate findings and provides evidence of validity for study results.[52] Further, tangible records, through the use of transcripts and detailed observation forms, should be complemented by field notes; this combination ensures that specific events can be captured along with abstract, but informative, observations.[52]

Grounded theory provides a useful framework for conducting and analyzing qualitative research in the field of community nutrition. When using a grounded theory approach, researchers analyze data without a pre-defined hypothesis in mind; instead, themes and concepts emerge organically during evaluation of the data to develop hypotheses that are setting-specific and appropriate for further investigation in the population of interest.[52] Analysis of data in a formative study guided by grounded theory can be efficiently achieved through the use of the constant comparative method, an iterative process where the researcher both codes and analyzes simultaneously to generate a substantive theory.[54] The generally inductive, grounded theory approach necessitates that data collection activities continue until the data are saturated (meaning that no new concepts emerge with the solicitation of additional data).[52,54] Incorporating the constant comparative approach offers a method for data reduction through the process of coding data into discrete categories while continually comparing those categories based on their conceptual content.[54] Taken together, these data collection and analytical practices are important to justify the underlying basis and methods to be used in a later intervention study,[55] as well as to tailor strategies and build rapport in the target setting. Particularly

because eating behaviors are complex and context-dependent, extensive formative research is necessary to ensure the success of new programs.

2.5.2 Curricula Relevant to Mindful and Sustainable Eating

Many relevant curricula to target nutrition, mindful eating, and food system education are publicly available with documented use. Review and selection of such resources offers an efficient means to compile an education program for students to learn about mindful and sustainable eating. A brief review of curricula used in this research are as follows.

FoodSpan is a freely available food system curriculum developed by John's Hopkins Center for a Livable Future and is designed for use with high school students.[56] Available lessons teach the full breadth of the food system, covering the following topics: industrial agriculture, crops and growing problems, raising animals for food, seafood, workers in the supply chain, climate, sustainability, transporting food, food safety, processing, food labels, marketing, influences on food choices, food waste, hunger, and policy.[56] While the lesson plans are intended for 9-12th grade students, the available resources are easily adapted to simplify concepts. The curriculum was designed in line with educational standards and uses active, inquiry-based learning techniques,[56] strategies that are relevant to ecoliterate education.[57]

Foodie U is a mindful eating curriculum for 3rd-5th grade students and their parents that was used as part of an nutrition intervention study.[58,59] The curriculum is available from California State University, Chico's extension program.[60] The program consists of six lessons, including: (1) learning to minimize environmental cues for

consumption, (2) describing sensory observations of food, (3) learning hunger and fullness cues, (4) building awareness of emotions related to food choices, (5) understanding resources used to grow, produce, and prepare food, and (6) preparing and participating in a mindful meal.[59,60] Lessons are relatively brief (approximately 45 minutes), focused on active participation, and include take home activities to reinforce concepts.[60]

Feeding Minds, Fighting Hunger is a curriculum developed by the Food and Agriculture Organization (FAO) of the United Nations.[61] It is designed to specifically teach children about concepts related to hunger, food insecurity, and malnutrition, and also includes broader messages about the food system.[61] The curriculum has adaptations for various age levels, including elementary school students. Because of its appropriateness for a younger audience, this program is useful when adapting curricula designed for older audiences (i.e. FoodSpan) to make lessons simpler and more understandable for children.

2.5.3 Related Instruments to Measure School-Based Eating Behaviors

Questionnaire design is a complicated task, with important considerations involving the questions (wording, order, length), available response options, format of the instrument, and mindset of the respondent, among other factors.[62] Responding to a survey question involves cognitive processing on the part of the respondent, beginning with comprehension and retrieval of information, and is influenced by the respondent's internal judgements and motivations.[62] The response, therefore, is a combination of the respondent's true answer plus an element of error as a result of the respondent's

interpretation and the question writer's clarity and specificity.[62] Developing a new questionnaire is a lengthy process, involving steps to review and test items, to ensure reliability and validity; for these reasons, adapting existing instruments may be a more efficient method. Two instruments used in this research were adapted from existing sources and a description of the original sources follows.

Eating behavior questionnaire: Although extensive work has been done to identify factors related to child and adolescent dietary behaviors and many interventions exist to address those behaviors, few instruments were identified that seek to measure changes in factors related to eating behaviors from a theory-based perspective. However, one such instrument, developed and evaluated by Dewar et al,[48] was identified. This questionnaire was designed for use in an adolescent population and measured healthy eating beliefs based on the major SCT constructs (self-efficacy, intentions, situation, social support, behavioral strategies, and outcome expectations and expectancies.)[48] Originally drafted by a panel of experts (ensuring content validity) and pretested with a focus group (ensuring understandability and offering an opportunity for cognitive testing of the instrument), it was then evaluated for reliability (using rank order repeatability and internal consistency) and validity (through confirmatory factor analysis) after administering to a sample of 173 adolescent students (mean age 13.72 ±1.24 years old). Evaluation of the instrument showed that it had good internal consistency ($\alpha = 0.65$-0.79), strong rank-order repeatability (ICC = 0.81-0.89), and acceptable data model fit to a hypothesized confirmatory factor analysis model (Dewar et al., 2012).

School environment audit: An observational checklist to assess school environments was developed as part of the "Wellness Champions for Change" intervention.[63,64] With design based in the RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework, an evaluation model to assess overall program performance,[65] the checklist itself was adapted from several published resources that have previously been tested, including the SL Scorecard.[66–68] The checklist includes a detailed protocol for data collectors to ensure reliability in measurements, and evaluates several aspects of the school environment, including: the cafeteria before, during, and following meal service; the school lobby; hallways; the school gym; and outdoor areas.[64]

2.5.4 Methodologies to Assess Food Waste

Measurement techniques for determining plate waste range in levels of accuracy. The use of weighed samples, where food items, either in total or individually, are weighed before and after the meal, is considered the most accurate method of measuring plate waste and frequently used as a reference measurement technique.[69–73] While accurate, weighing of samples requires considerable time in data collection and can be intrusive in meal service.[69,72,73]

Conversely, visual estimation methods are efficient with respect to time and labor and cause limited disruption to meal time, but have been found to be biased measures due to high variability of initial serving weights, with the coefficient of variation ranging from 5.5% to 24.7%.[70] The results of such studies, conducted in school cafeteria settings, highlight the need for portion standardization and control of initial servings if visual estimation of plate waste is desired.

Several visual estimation techniques exist, including the half-waste method, quarter-waste method, and Comstock method, and are essentially subjective rating scales used to quantify plate waste. The Comstock Method uses a 6-point scale [where foods are recorded as the amount remaining: 100% (5), >90% (4), 75% (3), 50% (2), 25% (1), or 0% (0)] has been routinely used as a method for assessing plate waste in cafeterias.[70,74,75] While Martins[70] found significant bias in the use of the Comstock Method, Navarro et. al[75] was able to demonstrate high interrater reliability (0.953 for full meal, 0.935 for vegetables, 0.99 for starch; $p<0.0001$ for all) when used in the controlled environment of a hospital.[70,75] The quarter- and half-waste methods are essentially simplifications of the Comstock Method; in the half-waste method, plate waste is recorded as "all," "some," or "none" remaining, and in the quarter-waste method, plate waste is recorded as all, ¾, ½, ¼, or none of the food remaining.[69] Compared to the use of weighed samples, half-waste and quarter-waste were found to have low reliability, due in part to the inability of researchers to estimate the quantity of foods in opaque containers (e.g. milk) in a strictly visual manner.[69] Fundamentally, the accuracy of all visual estimation techniques depends on the standardization of portions served and the flexibility of the chosen methodological approach to account for the limitations of visual estimation.[69,70] Because of its longstanding use and higher number of categories, the Comstock Method can be considered the most valid and reliable estimation scale.

The use of digital photography is an approach to extend the usefulness of visual estimation techniques and has been used routinely in the school setting. It is frequently cited as an acceptable and unobtrusive method that allows for quick data collection with limited intervening with participant's normal behavior.[75] When digital photography is

employed, researchers use a standard protocol to photograph student trays when served (before the student has begun eating) and once the student has finished; the photographs are then reviewed by researchers and a visual estimation scale is used to estimate the amount of plate waste.[71–73] Such studies have found that digital photography yielded estimates that were highly correlated with weighed foods (ρ ranging from 0.89 to 0.97, $p<0.01$) with high validity (less than 1.5 g discrepancy between weighed samples and photographic methods).[72,73] A similar study demonstrated high interrater reliability with the use of digital photography, where 2 independent researchers' estimates of meal components were within 10% of each other in 92% of cases (859 lunches measured over 4 days).[71] Supplementing visual estimation techniques by weighing foods in opaque containers (such as juice or milk) or adjusting trays to make all foods visible (for example, by removing chips from an opaque bag or removing napkins or peels that may cover other items) has been found to improve the validity and reliability of the method.[71–73]

2.6 Intervention Strategies to Support Reduced Food Waste and Improved Nutrition in School Settings

Examining findings and study designs of previous research is a necessary component of devising research questions and planned interventions. For this research, the procedures and outcomes of interventions that target student intake, waste behaviors, and related attitudes and preferences are relevant for designing a program to build on past knowledge and to identify gaps in the research base.

While interest is growing, relatively little work to address food or plate waste has been conducted in school settings, and no interventions that target these behaviors as a primary outcome in US schools have been identified. Two international studies, conducted in Portugal[76] and Korea,[77] were able to demonstrate plate waste reduction among students who received nutrition education. A case study in Sweden demonstrated dramatic waste reduction of over 40% after implementing a program to monitor waste created daily and a strategy where dessert was offered as a reward to encourage students to eat their meals.[78] Other research from Swedish schools recommends the use of pedagogic meals, where teachers eat with students as part of the instructional day, as an effective method to encourage more intake among students.[79] Finally, case reports from schools in the UK found cooking meals to order, modifying the dining environment, and using strategies to encourage familiarity and appreciation of school meals were effective in increasing awareness of issues related to food waste.[80]

While the experience from international researchers is useful, it is important to recognize that, because of differences in foodservice styles, some of the tested strategies are not applicable to a US population. For example, while the influence of pedagogic meals appears powerful, lunch in the US is typically an off-duty time for public school teachers, so this strategy is likely not feasible. Additionally, the use of food-based rewards to encourage students to eat more, though effective in reducing the overall volume of waste, could encourage overconsumption and could be problematic when considering USDA nutrition standards for school meals. Nevertheless, the available intervention studies show some promising concepts, and their usefulness and applicability to a US population can be better understood when considered in concert

with related work that has been conducted domestically. Food waste programs that have been implemented for the general public and school-based studies that emphasize nutrition promotion, mindfulness, or sustainability are related topics that can inform a program to encourage fruit and vegetable intake and reduced plate waste in schools.

2.6.1 Food Waste Reduction Strategies in the General Public

Several potential strategies have been suggested to reduce food waste in the general public that could be applied to the school setting. When evaluating strategies for reducing waste in restaurants and retail settings, survey respondents indicated that donating excess food (73%) would be an acceptable strategy, and suggested that offering more autonomy in meal selection (i.e. making food to order instead of serving ready-made items (37%)) could be useful in these settings.[22] When designing interventions to target food waste, Sharp, Giorgi, & Wilson recommend using a variety of enabling tools (including group challenges and strategies to ensure frequent follow-up) and engagement tools (including the use of websites).[81] Additionally, the authors found that self-weighing food waste had an important role in motivating participants to reduce overall waste and may provide a necessary "cue" to disrupt an established habit, indicating that this type of behavioral economics strategy may be effective.[81] Additional studies have demonstrated that nudging and targeted messaging through signage were effective in reducing food waste by 15-20.5% in college cafeteria and hotel buffet settings.[82,83] An exploratory study of 61 households found that those who had the most knowledge of environmental issues wasted the least amount of food; this finding supports the possibility that interventions

that incorporate education on the environmental impact of food waste may be beneficial.[84]

2.6.2 Strategies for School-Based Nutrition Interventions

Because of the need to balance food waste reduction efforts with child nutrition goals, review of nutrition promotion programs is necessary to inform the design of a school-based food waste reduction program. Additionally, there have been a multitude of studies that aimed to improve the healthfulness of children's diet and used plate waste as an indicator; the methods and results of such studies can be applied to future work that aims to reduce school food waste. Relevant interventions can be broadly categorized as education-focused interventions, interventions focused on behavioral economics or otherwise altering the school environment, and experiential interventions.

A recent review of school-based nutrition promotion programs concluded that education-focused interventions are more effective when designed in combination with school-wide approaches, including strategies that address school policies and incorporate interpersonal factors; this finding is consistent with prominent behavior change models.[85] School policy changes are an effective method for encouraging changes to the school environment and changing norms within the school community; as an example of effective policy changes, a breakfast promotion intervention of 7th graders found that the combination of nutrition education with policy changes (e.g. additional time in the schedule for breakfast and creation of an eating area) lead to greater increases in breakfast adherence in the intervention group than the control group.[86] Such policy

changes are tied to environment-level results and support desired behavioral changes in an effective, systematic way.[87]

A particularly effective area of research centers around the utilization of peer-led strategies when working with adolescent populations. One such program incorporated a "train the trainer" approach, where older children (11 years old) were taught the content of the nutrition curriculum and then delivered the information to younger children; the older children demonstrated greater increases in knowledge and greater improvements in the nutritional profile of snack choices than did controls.[88] The authors hypothesized that effectiveness of the train-the-trainer program resulted from empowering children with an opportunity to develop communication and life skills and through investing them in the program by concerning them with the health and welfare of their younger classmates.[88] An extension of the train the trainer approach is utilizing students as educators and motivators for their peers. A study of middle-school students combined nutrition education with peer-support groups and found that participants in the support groups had improvements in healthy behaviors.[89] Studies focused on younger populations found that students were more accepting of novel foods when they had opportunities to learn from peer modeling and were incentivized with rewards.[90] Peer-led strategies are frequently cited as effective strategies for behavior change, possibly resulting from improved acceptance when students receive health messages from their peers.[91,92] Those who serve as peer leaders may experience similar benefits. Research by Gutuskey et al[93] found that serving as a leader at school resulted in improved health behaviors as well as positive improvements in leadership and self-confidence. The additions of school environment changes and peer support to nutrition education programs appear to be particularly

effective in an elementary-school aged population and both are consistent with the framework of the SCT.

Interventions focused on behavioral economics have shown promise in positively influencing dietary behavior in children. Process evaluation of cafeteria strategies, that included specific placement of healthy target foods, and nutrition messages found that such methods had broad reach and were gauged as acceptable and feasible by providers.[68] Similar strategies in a large sample of middle and elementary school students (n = 2638) showed that students who were exposed to the intervention had significantly increased odds of choosing fruit (odds ratio [OR] = 1.45; 95% CI: 1.13, 1.87) and vegetables (OR = 1.91, 95% CI: 1.46-2.50); the magnitude of these ORs were further increased in schools that also received chef-enhanced meals.[94] Strategies that incorporate behavioral economics strategies can be supportive of increasing consumption, thereby decreasing plate waste and improving nutritional intake.

Experiential interventions include programs that incorporate cooking or gardening curricula, and, because of their similarities in nature to the proposed food waste reduction program, can be useful models for designing future interventions. Hands-on activities common in Farm to School programs have been found to improve children's attitudes and preferences for fruits and vegetables.[95] One example Farm to School program, which focused on exploring how food is produced and sourced through gardening and the utilization of local produce in school meals, found older elementary-aged students were more willing to try fruits and vegetables (1%, $p < 0.001$) and more frequently selected fruits and vegetables at lunch (6-17%, $p < 0.001$); additionally, among those with the lowest fruit and vegetable intake at the start of the study, fruit consumption increased by

135% ($p<0.001$).[95] A qualitative analysis of a gardening program in younger students (3rd grade) showed that those who participated in the program had positive increases in knowledge and attitudes, and schools that participated saw school-wide improvements in attitudes related to gardening.[96] Despite a lack of interventions directed at the food system, an interview-based study of older-elementary aged students elicited student understanding of various aspects of the food system supply chain, and showed that students have very little knowledge of what happens to food between the farm and store.[97] This finding highlights the potential for future interventions to target issues related to the food system and sustainability. While not a specific food system intervention, the Choice, Control, & Change curriculum utilized a hands-on, student-led science-based curriculum to instill personal agency and motivation to consume a healthier diet in an adolescent population; students who received the intervention consumed fewer sugar-sweetened beverages and snacks, smaller servings of fast food, and had improvements in self-efficacy, intentions, and other behaviors.[98] Together, these examples of successful experiential interventions highlight an opportunity to use a hands-on food systems approach to improve dietary behavior as well as influence positive aspects of an adolescent's personal development.

2.6.3 Mindful Eating & Mindfulness in School Settings

In typical reactions, sensory responses to stimuli are briefly recognized in objective focal attention before a cognitive or emotional response occurs.[99] Conversely, mindful reactions occur when attention serves only to register observations and stimuli are received without judgement.[99] In this way, mindful eating focuses on increasing

attention to and awareness of how eating behaviors affect a person both directly and indirectly. This is achieved by focusing on how physiologic needs, such as hunger and fullness, and related internal and external cues (such as emotions and environmental influences) influence food choices.[100] Mindful eating interventions in the general population have been effective in increasing preference for healthy foods such as fruit and ability to select smaller portions of energy dense foods.[100] Most mindful eating research has been conducted within the context of overweight/obesity management or in the treatment of eating disorders, and research outside the realm of weight management is limited.[99] Nevertheless, available research has shown mindful eating interventions to be effective in improving an individual's awareness of hunger cues and increasing selection of healthy foods.[99,101]

In school settings, general mindfulness strategies have demonstrated benefits related to positive changes in social behavior, emotional regulation, and academic performance.[102] A recent mindful eating intervention for 3rd-5th grade students was well-received by parents, educators, and students, and process evaluation indicates that students may have a higher preference for fruits and vegetables as a result of the program.[58] This program utilized education focused on sensory activities, hunger and fullness, and food exposure and aimed to foster a greater appreciation for the resources to produce and individuals who prepare food.[59] These strategies complement a recommendation by Fung et al. to expand current conceptualization of mindful eating to include awareness of how food choices are related to sustainability and social justice, in addition to how they impact the individual.[100] Intervention strategies related to mindful eating have the potential to positively influence fruit and vegetable intake of students,

while encouraging them to simultaneously consider the environmental and social implications of waste that they produce and may present an important opportunity to balance waste reduction and child nutrition goals.

2.6.4 Strategies to Support Environmental Sustainability in School Foodservice

Although often used to discuss the duration of measurable effects or activities following interventions, sustainability in this context instead refers to the impact of foodservice programs on the food system and environment in general. A sustainable food system is defined as one that supports economic and environmental longevity in the food supply, while providing long-term societal benefits.[103] A sustainable cafeteria, therefore, can be considered one that provides nutritious and acceptable food to students that is affordable with minimal environmental impact, provides opportunities for students to develop and practice behaviors that are supportive of their personal health and the health of the environment, and minimizes food waste through source reduction and diversion of unavoidable waste.

A useful construct to incorporate into the concept of sustainable lunchrooms, termed "ecoliteracy," has been defined by a group of experienced educators from the Center for Ecoliteracy and is an innovative perspective to use when developing future nutrition and food system interventions.[57] Without being explicitly stated, the theme of fostering ecoliteracy has been creatively woven throughout many of the successful experiential interventions described in previous sections. Ecoliteracy is a trait that is developed through a model of education where social and ecological factors are seen as symbiotic and where children and adolescents are encouraged to develop their own

creative strategies to solve complex health and environmental challenges; in doing so, they become engaged and effective leaders of healthy and sustainable communities and ecosystems.[57] When themes of sustainability and social justice are incorporated, development of mindful eating skills is supportive of behaviors that are both ecoliterate and healthful.[59] Because of the emphasis on the interplay between spheres of influence and the important role of children and adolescents as leaders, a program built from a perspective of fostering ecoliteracy in the participants is likely to be engaging and effective in positively influencing food waste behaviors.

Farm-to-school programs and school gardens provide a relevant basis to evaluate the impact of emphasizing ecoliteracy and sustainability in schools. Such programs education children by highlighting their relationship with the food they eat, the ecosystem in which they exist, and the community in which they live; in doing so, they appear effective in improving student intake and provide benefits to the community, environment, and economy.[104,105] Further, such experimental programs improve children's awareness, skills related to selection, and self-efficacy to consume healthy food.[104] When considered as a model for broader nutrition interventions that emphasize sustainability and ecoliteracy, farm-to-school programs and school gardens provide evidence that supports the role of such programs in improving nutrition, healthy behaviors, and the school environment.

2.6.5 Recommendations for Food Waste Reduction in School Settings

Because school meals provide a critical venue for supporting the health and nutritional status of students, it is necessary to recognize the implications of focusing on

food waste reduction in a school setting. If the primary emphasis is focused mainly on designing meals around existing student preferences, waste could be reduced by focusing on foods with the lowest rates of waste; however, using this strategy, likely unintended consequences include relaxed nutrition standards and increased consumption of less nutrient-dense foods. This approach would ultimately have a negative impact on student consumption and could override important hunger and fullness cues. So that waste reduction efforts are compatible with child nutrition goals, it is recommended that strategies emphasize improving student preference for and consumption of healthy foods, such as fruits and vegetables, which have been shown to have the highest rates of plate waste in schools.

As with identified strategies to reduce food waste in the general population, most recommended strategies for a school-aged population have not yet been tested. Some of the strongest recommendations resulted from a qualitative study of a school breakfast program, which utilized focus groups and in-depth interviews to identify potential strategies for waste mitigation; identified strategies included saving food for later, actively encouraging consumption, assisting children with food during mealtime, increasing staff support, serving smaller portion sizes, composting, and donating uneaten food.[24] The researchers ultimately concluded that changes to the menu and/or implementation logistics, as well as efforts to use leftover food productively, may be possible strategies of reducing waste and improving the economic, environmental, and nutritional impact of the school's food service programs.[24]

Additional recommendations have resulted from studies that sought to estimate food waste levels in schools. There is potential to reduce fruit and vegetable waste by

implementing complementary interventions to increase appeal of fruits and vegetables, thus highlighting the need to further assess collective impacts of school-based healthy food procurement practices on health.[34] It has also been suggested that increasing student autonomy in selecting foods, shifting daily schedules so that lunch is after recess, improving quality and acceptability of food, and providing nutrition education to students would be helpful strategies for reducing plate waste.[15] It is recommended that future interventions focus on nutrition education, marketing communications, and behavioral economics as effective strategies to ensure that students are meeting nutrition recommendations.[35] Ultimately, interventions should center around developing strategies that assist students and programs in meeting nutrition needs without excess and providing avenues for new methods of disposing of unavoidable waste that are more environmentally friendly and socially conscious.

2.7 Summary

It is well understood that food waste is a large and growing problem. Food waste levels in schools are dramatic, but little is known about the impact of food waste on student consumption or specific determinants of and solutions to the food waste problem. Because a key goal of school meals programs is to provide nutritionally balanced and adequate meals for students, waste in the programs has the potential to threaten the healthful development of children. This review of the literature highlights specific opportunities to build upon prior effective studies and fill continued gaps to design a comprehensive, theoretically-based program that is developmentally appropriate for an elementary school aged population and has the potential to promote improved nutritional

consumption while reducing food waste. By implementing a program to encourage increased fruit and vegetable consumption through the development of mindful and sustainable behaviors in an elementary school population, the results have the potential to positively impact the health and nutritional status of growing children, while simultaneously having a positive impact on school finances and natural resources of the community.

CHAPTER 3: METHODS

3.1 Conceptual Framework

FTTF is an intervention that encourages elementary school students to develop mindful and sustainable eating behaviors. The design of the conceptual framework for *FTTF* draws primarily from SCT.[41,43]

SCT is frequently used in youth programs emphasizing nutrition education, behavior change, and the food system.[39,43,46] Research shows evidence that dietary behavior is predicted by important SCT constructs, including: self-efficacy, outcome expectations, knowledge, social support, modeling/observational learning, and availability of food.[43,51] Along with SCT's longstanding use targeting youth behaviors, identification of these constructs supports its selection as the theoretical foundation to encourage development of mindful and sustainable behaviors among children. The conceptual framework for *FTTF* is shown below in **Figure 1.**

Constructs included in the conceptual framework were initially identified through an extensive literature review. A chief objective of the formative study was to more fully develop the framework, and results were used to refine and prioritize the included constructs. The resulting framework can be considered a behavioral model that, based on rigorous qualitative work, explains mindful and sustainable eating behaviors of elementary school students. Results of the formative strategies used to target identified constructs are outlined in **Table 1** and will be described in greater detail in subsequent sections.

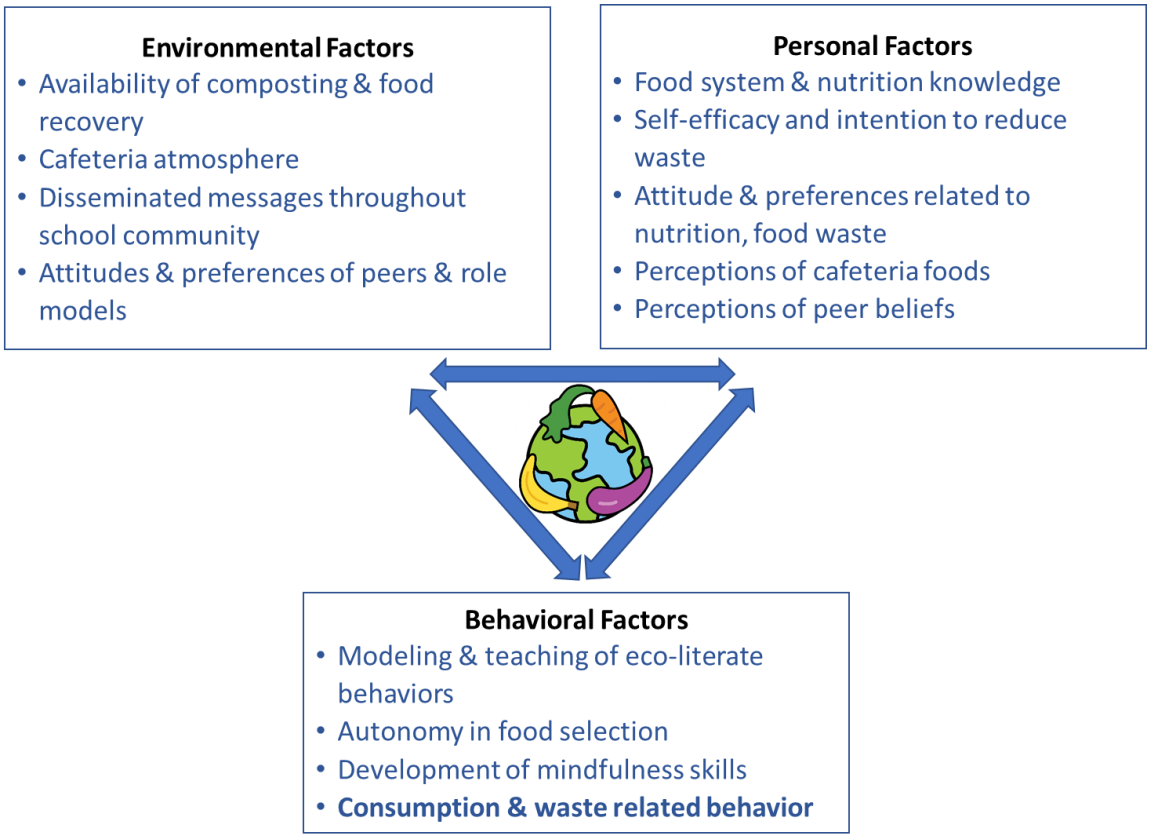


***Figure 1**: Conceptual framework of FTTF program*

Table 1: *Psychosocial constructs to explain mindful and sustainable eating behaviors and targeted strategies*

SCT Level	Construct	Program Strategies
Personal	Food system & nutrition knowledge	Education curriculum Educational signage prepared by Veggie Leaders
	Self-efficacy to reduce waste	Creation of expanded share table Introduction of mindfulness concepts related to food selection
	Intention to reduce waste	Educational signage/announcements related to outcomes of food waste and resources used to produce food Health fair activity to brainstorm ways to reduce waste
	Attitudes/preferences related to nutrition & food waste	Activities incorporated into curriculum and mindful eating contest
	Perceptions of cafeteria foods	Signage on descriptive/non-judgmental words to discuss food
	Perceptions of peer beliefs	Building leadership skills in Veggie Leaders Feedback board Prizes distributed to contest participants Morning announcement to share favorite vegetable
Behavioral	Modeling & teaching of ecoliterate behaviors	Dissemination activities by Veggie Leaders
	Autonomy in food selection	Fruit and vegetable menu board Labeling items in tray line
	Development of mindfulness skills	Guided mindful eating practice for Veggie Leaders Mindful eating information shared through announcements Mindful eating contest
	Consumption and waste-related behavior	Expanded share table
Environ-mental	Availability of food recovery	Expanded share table
	Cafeteria atmosphere	Education on sensory exploration of food (mindful eating contest) Education on understanding hunger cues
	Availability of a la carte items	A la carte items not specifically addressed due to budgetary implications; Provision of healthy snacks via share table
	Disseminated messages throughout the school community	Veggie Leader activities Educational signage Feedback board Consistent branding
	Attitudes/preferences of peers & role models	Veggie Leader activities

3.2 Study Overview

The goal of this research was to develop, implement, and evaluate a school lunch-based nutrition promotion program that emphasizes mindful and sustainable eating in order to encourage increased consumption of fruits and vegetables and reduce plate waste among elementary school students. This project was conducted in two phases in elementary schools in Caroline County, MD: 1) a formative study and 2) a pilot intervention trial.

1) Formative study: This phase was conducted at three elementary schools between April – June 2018 with the goal of developing a more thorough understanding of psychosocial factors related to mindful and sustainable eating to refine the behavioral model depicted in the conceptual framework. Methods used included: focus groups with students (n = 50), interviews with school staff (n = 15), and cafeteria observations (n = 9). Cafeteria observations were meant to identify normal cafeteria practices, behaviors, and environmental factors that influence student eating and waste behaviors, environmental factors that may present logistical challenges or considerations, and, at one school that participated in a composting program, considerations for expanding the program to additional schools in the county. Observations were begun prior to focus groups and interviews to identify any topics that should be further explored in those activities.

The objective of the formative study overall was to primarily understand student perspectives related to healthy eating, mindfulness, and sustainability, including their knowledge, opinions, and beliefs about causes and outcomes of each topic. The formative study used triangulation methodology[52,106] to solicit additional information from adults in the school and first-hand observations to complement student reports. Formative

activities also explored feasibility, acceptability, and logistical considerations for potential program strategies that could result in improved student intake and reduce plate waste with students and staff, allowing for refinement of the pilot intervention protocol.

Finally, the formative study provided an important opportunity to build relationships with influential individuals in the school system who could serve as project champions, including the foodservice supervisor, county dietitian, school principals, cafeteria managers, and wellness chairpersons. While these relationships were not formal aspects of the protocol or evaluation plan, they set the stage for a more successful intervention. Developing relationships with adults in the schools was intended as a means of identifying less quantifiable needs and priorities of the school and to provide a similar opportunity for the school to understand the motivations and goals of the researcher, leading to a collaborative and mutually beneficial intervention.

2) Pilot program: The second phase pilot tested an intervention known as *FTTF* and was conducted at two elementary schools in the same school system where formative work was completed. Using a quasi-experimental design, one school was the intervention site and one served as a control. The intervention ran from January – June 2019. Four main strategies were used as part of the intervention: 1) mindfulness- and sustainability-focused education to build capacity among students to increase produce consumption and create less waste at lunch, 2) dissemination activities by student leaders to offer modeling and leadership opportunities, 3) cafeteria changes to incorporate environmental reinforcements of study messages, and 4) development of a food recovery program to provide a new avenue for disposal of uneaten foods.

Program strategies were designed to target as many constructs in the conceptual framework as possible. Education was delivered to a group of student leaders (termed the "Veggie Leaders") during 16-weekly meetings, with the goal of improving their personal factors (knowledge, attitudes, perceptions, etc.) and skills to participate in mindful and sustainable behaviors. Simultaneously, the Veggie Leaders planned activities which were intended to improve personal factors and behavioral skills of the rest of the student body, incorporate opportunities for modeling and teaching target behaviors to peers, and influence the school environment by disseminating study messages. The remaining strategies targeted the school environment overall and offered opportunities to practice new behaviors.

Two key outcomes were measured during the pilot study to evaluate changes from baseline to follow-up: 1) the produce and nutrient content of foods selected, consumed, and wasted among elementary school students who eat school meals, and 2) changes in psychosocial factors related to mindful and sustainable eating behaviors among older elementary school students (3^{rd} – 5^{th} grade) who completed a survey. Additionally, school-level plate waste was monitored over the course of the study.

3.2.1 Design & Setting

Research was conducted in elementary schools in the Caroline County Public School System. Caroline County is a rural county on MD's Eastern Shore, with a population of approximately 32,850 people, 81.3% of whom are white.[107] There are minority populations of other racial and ethnic groups, the largest of which are black/African American (14.0%) and Hispanic/Latino (7.2%).[107] Median household

income in Caroline County is below the state average ($52,967 in Caroline County, vs. $72,345 for all of MD) and 14.4% of the population lives in poverty (compared with the MD average of 9.7%).[107] Although not ethnically diverse, the population is financially vulnerable and represents an appropriate target for a school-lunch based nutrition promotion intervention. The proportion of students in the county's elementary schools who qualify for free and reduced-price meals (FARM) is over 50% and the NSLP participation rate for these schools is approximately 60% of all students.

This county in particular was chosen to build on community-focused initiatives that have been spearheaded by the school system's food service director, Amanda Beth Brewster. Mrs. Brewster has forged a number of important relationships with organizations and influential stakeholders in Caroline County. As her community initiatives have earned her a great deal of social capital, collaborating with Mrs. Brewster as a key partner of the project likely led to greater buy-in, and therefore better ability to test intensive protocols with fewer logistical barriers, than if it had been tested elsewhere.

The formative study used a mixed-methods approach of triangulation of data sources, specifically through focus groups, semi-structured interviews, and observations. The pilot intervention used a quasi-experimental controlled design to allow for the comparison between schools. The small size of the school system unfortunately did not allow for random selection of schools but, on the advice of Mrs. Brewster and school principals, the two most comparable schools were invited to participate in the pilot. The schools had some existing differences in terms of size and student demographics but served the same menus, had cafeterias with the same lay out, and used very similar foodservice practices.

Specifically, the intervention school was larger (825 students vs. 722 at the control school in school year 2018-2019)[108] with a larger minority population (approximately 45% of students compared to 34% at the control school).[109] Additionally, a substantial difference in the proportion of students eligible for FARMs exists between the schools, where 70.18% qualify at the intervention school and 47.23% qualify at the control school (school year 2018-2019).[108] The difference in FARM-eligible students is important to acknowledge. Despite anecdotal reports from school staff who did not believe that students ate differently at the schools, previous research indicates students who are FARM eligible may consume fewer competitive foods[110] and have higher likelihood of participating with NSLP[111] than students who do not qualify. Nevertheless, a great deal of emphasis for this pilot study was placed on the school environment, and the similarities of cafeterias/cafeteria practices indicated that the comparison of these two schools was the best available option.

3.2.2 Subjects

The formative study and pilot intervention target an elementary school-aged population. This age group (kindergarten – 5th grade) was selected because prior research has shown elementary school students have the highest rates of plate waste.

Students were eligible to participate in the focus groups if they were 3rd-5th grade students at the selected elementary schools in Caroline County, and if they have returned a signed parental informed consent form. Staff were eligible to participate in interviews if they were a school administrator or had knowledge of student eating behaviors. During the formative study, 50 3rd-5th grade students participated in five focus groups and 15

staff members were interviewed. The age distribution of focus group participants and their reported frequency of consuming school lunch is shown in **Table 2**. Among interviewees, 13 worked at each of the three schools (including 6 foodservice personnel, 5 administrators, 3 wellness chairpersons, and 1 custodian) and 2 worked at the county-level (the school system's foodservice supervisor and registered dietitian).

***Table 2**: Grade distribution and frequency of school lunch by focus group participants*

	Total sample	**School A[1]**	**School B[2]**	**School C**
Number of participants (%)	50	21 (42%)	19 (38%)	10 (20%)
Number in 3rd grade (%)	11 (22%)	7 (33.33%)	0 (0%)	4 (40%)
Number in 4th grade(%)	17 (34%)	6 (28.57%)	6 (31.58%)	5 (50%)
Number in 5th grade(%)	22 (44%)	8 (38.10%)	13 (68.42%)	1 (10%)
Number of students who buy lunch at least occasionally	36 (72.00% of total)	18 (85.71%)	15 (78.95%)	3 (30.00%)
Among students who buy lunch at least occasionally				
Number who buy daily (%)	19 (52.78%)	13 (72.22%)	5 (33.33%)	1 (33.33%)
Number who buy 3-4 days/week (%)	3 (8.33%)	1 (7.69%)	2 (40.00%)	0 (0.00%)
Number who buy 1-2 days/week (%)	9 (25.00%)	3 (16.67%)	4 (26.67%)	2 (66.67%)
Number who buy <1 day/week (%)	5 (13.89%)	1 (5.56%)	4 (26.67%)	0 (0.00%)

[1] Served as the intervention school in the pilot trial
[2] Served as the control school in the pilot trial

During the pilot intervention, students in all grades were eligible to participate in meal observations if they ate school lunch on the day that their class was observed. All older elementary school students (grades 3 – 5) in recruited classes were eligible to complete the survey, regardless of their frequency of consuming school meals. Younger students were not asked to complete the survey because of its advanced reading level.

Because of variations in student lunch habits (where many students buy or bring lunch on some, but not all, school days) and in school attendance, the baseline and follow-up samples varied. As many students as possible were included in the data collection activities (for example, students who did not remember participating in baseline meal observations were still invited to participate in the follow-up measurement) in an attempt to maximize the number of students who completed all measurements. In total, 430 students participated in the study in some way. Among them, 162 kindergarten – 5th grade students participated in meal observations at baseline and follow up and 169 3rd-5th grade students completed both administrations of the survey. A total of 87 students participated in all of the data collection activities. A full breakdown of participant grade level and school assignment is shown in **Table 3**. All students in selected classes who ate school lunch on data collection days were eligible to participate in school-wide food waste audits.

***Table 3**: Grade distribution of pilot intervention participants (n = 430)*

Site	Grade	Meal observations			Psychosocial Survey			Meal observations and survey		
		Pre	Post	Both	Pre	Post	Both	Pre	Post	Both
Intervention	K-2nd Grade n (% of subgroup)	62 (37.8)	76 (43.9)	49 (40.2)	--	--	--	--	--	--
	3rd – 5th Grade n (% of subgroup)	102 (62.2)	97 (56.1)	73 (79.5)	131 (62.4)	113 (58.5)	102 (60.4)	81 (68.1)	76 (64.4)	64 (73.6)
	Sub total n (% of total)	164 (69.8)	173 (68.4)	122 (75.3)	--	--	--	--	--	--
Control	Kindergarten-2nd Grade n (% of subgroup)	26 (36.6)	32 (40.0)	12 (30.0)	--	--	--	--	--	--
	3rd – 5th Grade n (% of subgroup)	45 (63.4)	48 (60.0)	28 (70.0)	79 (37.6)	80 (41.5)	67 (39.6)	38 (31.9)	42 (35.6)	23 (26.4)
	Sub total n (% of total)	71 (30.2)	80 (31.6)	40 (24.7)	--	--	--	--	--	--
Total		235	253	162	210	193	169	119	118	87

3.2.3 Recruitment Protocol

Three of the five elementary schools in Caroline County were asked to participate in the formative study and two were asked to participate in the pilot trial. One of the schools (School C in **Table 2**) that participated in formative activities had a composting program; as this could have influenced student behaviors, this school was not asked to participate in the pilot intervention. Additionally, focus group findings showed a smaller percentage of students at School C participated in NSLP meals, indicating that students at that school had lunch behaviors that appeared most unlike the other two schools.

Approval from the University of Maryland, College Park Institutional Review Board and research approval from the Caroline County School System were obtained prior to recruiting schools for the formative study. A separate IRB application was filed, and approval received, prior to beginning the pilot trial. Communication with the school system was ongoing during all phases of the research to ensure that all activities met their requirements. Written informed consent was obtained from parents of students who participated in focus groups and an assent script was read to students at the start of each group. Parents of students who participated as student leaders during the pilot trial provided written informed consent, along with contact information, should they have needed to be reached during the study. Parental consent was not required for students who participated in general pilot study data collection activities, as they were not identified in any way. A notice was sent home to parents informing them of planned activities and explaining their and their child's right to not participate. Similarly, an assent script was read to students on data collection days to remind them of this right.

Adults who participated in interviews provided written informed consent prior to interviews.

Recruitment for all phases occurred by convenience sampling, which was planned in conjunction with school principals. During the formative phase, principals at each school distributed approximately 60 announcements for focus groups (each with a parental consent form attached) to 3rd-5th grade students. Interested students returned completed forms to the school's office, which were picked up by the researcher prior to holding groups. Focus group participants were given a reusable water bottle as an incentive to join. For interviews, persons known to the researcher (principals and the foodservice supervisor) were initially approached and invited to participate. At the end of their interviews, they were asked for recommendations of other knowledgeable people in the schools who might be interested; those individuals were then approached and invited to participate in interviews. No one who was asked to participate in an interview declined.

During the pilot intervention, principals were asked to forward a brief announcement about the study to teachers in their school; teachers who were willing to have the researcher contact their students were asked to respond directly. Two follow-up emails were sent to ensure that an adequate sample size could be obtained. In total, 12 teachers from the intervention school and 8 from the control school volunteered to participate and were enrolled. After willing teachers were identified, study announcements were distributed to all students in their classrooms. Announcements were made to these students on the day of data collection, either by making a brief presentation in their classroom in the morning or, when necessary, greeting them as they entered the

cafeteria. The content of announcements was the same no matter which method was used – planned activities were explained to students, they were reminded of their right to not participate, and they were invited to ask questions. No formal incentive was offered to students who participated in pilot intervention data collection activities, but *FTTF* stickers were distributed throughout the program and students who completed program contests received branded t-shirts as prizes.

Student leaders in the pilot study were recruited by distributing a project announcement, application, and parental consent form to all 5th grade students at the intervention school (approximately 130 students.) Formative feedback indicated that having students apply to be a student leader would increase interest by making the program appear "exclusive." Additionally, this provided an opportunity to evaluate the student's interest in participating, in case students who might not actively contribute to the group applied, although all of the applicants appeared interested and motivated and this form of screening was not necessary in this implementation. Students enrolled by returning the completed application and parental consent form (which also ensured that parents were aware of meeting times to minimize transportation barriers) to their teacher, who relayed the forms to the researcher. A goal was set to enroll 10 student leaders. Nine students completed applications and were enrolled; 8 participated for the entirety of the program (one student dropped out due to a change in transportation availability.)

3.3 Formative Study Protocols

Development of assessments was guided by SCT, a framework commonly used when designing health promoting interventions in this population.[40] Potential constructs

in three factors, identified through an extensive literature review, were considered when planning assessments: personal/cognitive (knowledge of the food system and nutrition, attitudes and preferences related to food and food waste), behavioral (waste and consumption patterns, motivators and barriers related to those behaviors), and environment (available food, social norms, and disseminated messages throughout the school community). As stated, the main goals of formative work were to improve understanding of the relative importance of these factors, identify additional constructs, and develop contextual understanding of other relevant considerations in order to more fully develop the conceptual framework that explains mindful and sustainable eating behaviors of elementary school students.

Formative activities included focus groups (5 groups with n = 50 3^{rd} – 5^{th} grade students), semi-structured interviews (n = 15 school faculty and staff), and cafeteria observations (n = 9). While the main emphasis was on understanding students' perspectives, it was anticipated that feedback from school staff and cafeteria observations would complement focus group findings.

Interview and focus group guides were developed using triangulated methodology to solicit feedback in key areas (outlined in **Table 4**) and converge different information sources**.** The study examined 1) student knowledge/perceptions of healthy diet, mindful eating, and sustainability, 2) perceived causes/magnitude of plate waste, and 3) possible school-based strategies to reduce waste and encourage healthy eating. Photos were used as prompts for focus groups to ensure questions were understandable. Materials for all activities were reviewed with subject experts to ensure content validity. Field notes, audio

recordings of interviews and focus groups, and verbatim transcripts were generated from these activities.

***Table 4**: Key areas of focus for interview and focus group guides*

Theme 1: Student knowledge and perceptions of healthy diet, mindful eating, and sustainability		
Sub-themes	*Focus Group question/prompts*	*Interview question/prompt*
Perceived definition of healthy eating	- Can anyone tell me what they think healthy eating is? - How do people know how much food they should eat? - How do people know when they have eaten the right amount of food?	- Do you think they know enough about what healthy eating is? - Do you think your students eat enough healthy food during lunch?
Concept of mindful eating	- Is it easy or hard to know how hungry or full you feel? - Do the foods that you want to eat change when you feel more less hungry? - Are there things that make it tougher to know how hungry or full you are?	- Do you think your students would be interested in learning about nutrition, the environment, and/or mindfully choosing and eating food that is healthy for them and more sustainable for the planet? - Do you think they would be interested in learning from their peers?
Perceptions of food waste & sustainability	- Has anyone ever heard of the word "sustainability"? What does it mean? - Does anyone think about ways to take care of the planet? What are some of the ways? - Does anyone think that what we choose to eat is related to the sustainability of our planet? Are some foods better for the earth than others? - What about the food that we throw away, is that related to the sustainability of our planet? How?	
Theme 2: Perceived causes and magnitude of plate waste		
Sub-themes	*Focus Group question/prompts*	*Interview question/prompt*
Causes of plate waste	- Why do people throw away food? - Why do you throw away food?	- Why do you think people throw away food? - Why do your students throw away food? - What is your opinion on the quality of food that is served? Do you eat any of the food served to students? What do you like and not like about it?
Magnitude and types of foods wasted	- Do you think people usually throw away a lot of food? How much is a lot? - What foods do you think kids throw away the most at school? What are these the foods that kids throw away?	- About how much food do you think is thrown away at lunchtime? - Which foods do you think are thrown away the most? - Do you think the amount of food that your students throw away is a problem?

	- Do you think most of the food that kids throw away is healthy for them? Are there any ways to help kids like some of those healthy foods better?	What about the type of food that is thrown away? - In general, do you see any problems related to throwing away food?
Theme 3: School-based strategies to reduce waste and encourage healthy eating		
Sub-themes	*Focus Group question/prompts*	*Interview question/prompt*
Current strategies to reduce food waste	-	- Do you ask for feedback from students about the food? How? - How is that feedback used for menu planning?
Possible pilot program strategies and interest	- Can you think of any ways to encourage kids to eat more fruits and vegetables at lunch? - Can you think of ways to encourage kids to throw away less food in general? - Can you think of ways to encourage kids to throw away less of their fruit and vegetables? Why do you think these ideas will work? Can you think of any reasons why these ideas might not work? - Do you think the other kids in your class would like this program? Why? - What are some ways that I could make a program like this more fun?	- Would it be possible to have a program [to encourage mindful and sustainable eating and discourage excessive plate waste] at your site? - What kind of time commitment would be reasonable? - What time of day do you think would work best to deliver lessons? - Do you think there is anyone who works at the school or is part of the PTA that might be interested in helping with this kind of program? - Are there any "behind the scenes" changes that you think would be helpful in encouraging students to throw away less food? - Can you think of any barriers related to student interest in this kind of program? - What could I do to make sure students enjoy and are engaged with a program like this? - Can you think of anything else that would make a program like this successful?
Logistics	- Have you had any classes or programs about food or nutrition before? What did you like and not like about them?	- How long does it typically take students to go through the tray line? - you often have to ask students to take more or different items so they have a reimbursable meal? How much effort do you have to give to make sure students have the required components? - Can you please describe what the interaction with students is like when they are in the tray line? - Is lunch monitored by anyone outside of the cafeteria staff? What kind of interaction do they have with students?

3.3.1 Cafeteria Observations

Three full lunch periods, each approximately 3 hours in length, at each school (n = 9) were observed to understand environmental factors that may influence consumption and waste patterns. An adapted version of a structured cafeteria observation form,[64] which itself was originally developed from the SL Scorecard, was used to evaluate general layout/flow, available foods, foodservice practices, and interaction among adults and students. Additional attention was focused on observing lunchroom turnover practices, how students discarded remaining food, and which foods were commonly discarded. Cafeteria observations began before focus groups and interviews, offering an opportunity to incorporate additional topics into guides that warranted additional evaluation. A summary of lunchroom characteristics observed is provided in **Table 5**.

Table 5*: Observed cafeteria characteristics*

Area/topic	**Item observed**	**Criteria noted**
Dining area atmosphere	Posted menu with current day's options	Location, size, content; photos taken
	Posted menu with previous day's options	Location, size, content; photos taken
	Posted calorie count or nutrition information	Presence or absence; photos taken
Service line atmosphere	Posted menu with current day's options	Location, size, content; photos taken
	Posted menu with previous day's options	Location, size, content; photos taken
	Posted calorie count or nutrition information	Presence or absence; photos taken
Marketing & signage in dining area	Branding or decoration that reflects student body	Presence or absence and description; photos taken
	Share table	Availability; photos taken
	Signs related to healthy eating	Number; photos taken
	Signs related to unhealthy eating	Number; photos taken
	Signs related to physical activity	Number; photos taken
	Water fountains or cools	Presence or absence, location, availability of cups; photos taken
	Trash/debris	Presence or absence; description; photos taken
	Dust, dirt, or residue	Presence or absence; description; photos taken
	Graffiti or damaged property	Presence or absence; description; photos taken
Service line fruit	Fruit options	List of available choices
	Sliced or cut fruit	Availability

	Fruit in at least two locations	Availability
	Quality of fruit	Description of any browning/bruising
Service line vegetables	Vegetable options	List of available choices
	Hot and cold options	Indicate if both are available; specify which
	Quality of cold vegetables	Description of any wilting/dull
	Vegetables noticeably incorporated into entrée item	Availability; specify which entrée
	Self-serve spices, seasonings to flavor vegetables	Availability
	Pre-packaged salads and/or salad bar	Availability
Service line beverages	While milk	Offered in all beverage areas
	White milk displayed in front of other milks	Presence or absence
	Free water	Availability
Service area marketing & signage	Entrée identified as featured menu item	Availability; description
	At least one fruit is identified as fruit of the day	Availability; description
	At least one vegetable is identified as vegetable of the day	Availability; description
	Creative, descriptive naming	Presence or absence; list and describe
	A la carte items	Availability during dining service
Dining area atmosphere	Organized start to meal service	Presence or absence
	Cleaning supplies, broken/unused equipment	Visibility during mealtime; photos taken
	Lights	On/off during mealtime
	Trash cans	If emptied when full
	Location of trash cans	If at least 5 feet from dining students; photos taken
	Teachers or staff	If eating in cafeteria
Service line atmosphere	Students waiting in line when lunch ends	Presence or absence
	Cleaning supplies, broken/unused equipment	Visibility in service lines; photos taken
	Lights	On/off in service line
Waste disposal	Procedure/behaviors	Photos of 10 trays immediately before students discard
	Composting	Availability; description of procedure; photos taken
	Composting signage, instructions, and assistance from staff	Description; photos taken
	Compliance with composting	Observation and description of 10 students sorting food
	Acceptable foods	List of compostable foods
Share table	Signage	Availability
	Ice or refrigeration	Availability
	Procedures at end of lunch	Description of how remaining foods handled
Additional photos: General dining area immediately before meal service, general service area, tray line with available hot foods immediately before meal service, beverages and a la carte options		

3.3.2 Focus Groups with Students

Five focus groups with 3rd – 5th grade students (n = 50) were held during the school day. Students were asked about concepts related to nutrition, mindful eating, and sustainability, and opinions about the amount and types of foods often wasted, both in general and in the school environment. Finally, they were asked several questions to gauge interest in a future intervention.

Prior to beginning, students were reminded of their right to not participate and informed that the questions/prompts were intended to solicit their opinions rather than any right or wrong answers. Students were then asked their permission to audio record the session (no student objected.) Photos were used as prompts for some focus group questions; for example, after asking students what they learn about nutrition in school, a MyPlate diagram was shown and students were asked if they recalled seeing it in school, where, and in what context. The lead researcher moderated the discussion, with a research assistant present to take notes. The sessions were one hour in length, with the first 45 minutes spent in the moderated discussion and remaining 15 minutes for students to pilot test a draft psychosocial questionnaire to be used in the pilot intervention. Students were instructed to ask for clarification and to identify any questions, words, or concepts that they did not understand. This offered an opportunity to refine the instrument prior to the pilot study to ensure that it was understandable and of an appropriate reading level for 3rd-5th grade students.

3.3.3 Interviews with School Staff

Fifteen interviews with school nutrition personnel, administrators, and other staff members were conducted. Each interviewee was provided a written informed consent and, after signing and agreeing to continue, asked if they had any questions before beginning. Interviewees were asked for their permission to record the conversation; none objected. Interviews generally lasted between 15 and 30 minutes. During the interviews, staff were asked to discuss opinions regarding student eating and food waste behaviors and perceptions of barriers or facilitators to behavior change. Food service staff and administrators were asked logistical questions related to meal service. Next, interviewees were asked for opinions about various possible program strategies. Before concluding the interview, they were asked if they had any additional comments, feedback, or priorities that the researcher should be aware of.

3.4 Pilot Intervention Protocols

The *FTTF* program consisted of a 16-week mindfulness- and sustainability-focused nutrition curriculum delivered to a small group of 5^{th} grade students (n = 8), dissemination of study messages by those same students, updated cafeteria signage to promote produce consumption, and development of an "expanded" share table in the cafeteria. This expanded share table functioned like a typical share table/bin, where students could donate or select additional sealed cafeteria foods, but was marketed with eye-catching signage and displays to offer a mechanism to save and recover food left at the end of the day's lunch (when it would have otherwise been discarded.) The 5^{th} grade students, known as the "Veggie Leaders," convened weekly as a club, where they were

taught a brief lesson on nutrition, mindful eating, or the food system and then developed plans and materials to disseminate what they learned to the school community, which they delivered during school hours. Dissemination activities included hosting a school-wide mindful eating contest, making morning announcements with key facts, creating and posting informational artwork, and writing an educational story for young schoolmates. Lessons for the curriculum were compiled from several published resources or written by the lead researcher.

The intended audience for this project was the entire student body. The main outcomes, measured from students in all grades, were student intake during lunch and the amount of plate waste produced per student. Secondary outcomes included plate waste measured at the school level and changes in psychosocial factors, such as attitudes and beliefs related to mindful and sustainable eating behaviors, measured from students in upper-level grades (3^{rd} – 5^{th}).

3.4.1 Student Leaders & Curriculum

FTTF's 16-week curriculum aimed to increase student capacity to consume produce and reduce waste during lunch. Delivery was intended for Veggie Leaders, who act as student leaders, during 45-minute weekly meetings. The meetings were held weekly before school, as the school's principal indicated that, in her experience in this particular school, transportation for extracurricular activities was generally less of a barrier when they were held before school rather than after. Lessons were adapted from published resources and intended to target personal level constructs and were structured into 8 modules, each covered during the first half of meetings over a two-week period.

This arrangement offered flexibility, as timing could be adjusted based on Veggie Leader interest, and an opportunity for the Veggie Leaders to complete tasks between meetings, like observing the school food environment to discuss the following week.

The introductory lesson was based on MyPlate and was developed by the lead researcher. Three lessons, adapted from *Foodie U*, [58,59] were devoted to mindful eating and emphasized sensory exploration of new foods, understanding hunger cues, and recognizing the value inherent in foods. The remaining lessons, adapted from *FoodSpan*[56] and *Feeding Minds, Fighting Hunger*,[61] focused on understanding the food system from environmental and social perspectives. Food system lessons covered the food supply chain, influences on food choices, environmental impact of food waste, and hunger. Lessons were participatory, utilizing activities/games to convey information and practice new skills. The specific topics, activities, and methods for dissemination are delineated in **Table 6.**

***Table 6**: Overview of curriculum content*

Lesson	Education Activities	Dissemination Activities
MyPlate	- Matching game for foods/ food groups; - Sharing health benefits of favorite FV	- Morning announcement; - Educational artwork for cafeteria
Exploring our Food System[1]	- Game to visualize connections in food system; - Reading abbreviated version of "Miguel's Tomatoes"[3]	- Morning announcement; - Writing a simplified version of story and creating a presentation for young students
Sensational Senses [2]	- Creating list of non-judgmental descriptors for food; - Exploring foods using all senses	- Morning announcement; - Prepared materials for contest – adapted worksheet for "Five Senses Snack"
Why We Eat What We Eat[1]	- Debate on causes of food choices; - Creating artwork to depict "healthy food environment"	- Morning announcement; - Brainstorming ways to adapt cafeteria to encourage healthier choices
Getting to Know Hunger and Fullness[2]	- Demonstration of hunger and fullness using variety of scales; - Group snack to practice understanding physical sensations	- Morning announcement; - Creation of large hunger/fullness scales for cafeteria; - Prepare materials for contest – adapted worksheet for "Hunger Check Snack"
Our Wasted Food[1]	- Discussion of food waste generated throughout the supply chain; - Decoration of food recovery hierarchy worksheets for cafeteria	- Morning announcement; - Health fair table – Veggie Leaders solicited ideas to reduce waste and provided written information to parents
The Hunger Gap[1, 3]	- Discussion of food insecurity; - Journaling activity – students privately wrote/ drew about feelings about community food insecurity	- Morning announcement; - Creation of artwork for cafeteria to promote food recovery
Planting the Seeds of Mindfulness[2]	- Students started vegetable seeds to demonstrate effort involved in food production; - Mindful eating practice	- Morning announcement; - Prepare materials for contest – adapted version of "Thankful Thoughts" worksheet

[1] Adapted from *FoodSpan* curriculum; simplified for audience age
[2] Adapted from *Foodie U* curriculum; lessons shortened for time constraints
[3] Messages from *Feeding Minds, Fighting Hunger* incorporated into lesson

3.4.2 Dissemination Activities

The Veggie Leader's main role was to model behaviors and act as leaders through a variety of self-directed dissemination activities. Each week, students prepare materials/activities to disseminate concepts covered in that week's lesson to the school during the second half of the meeting time. Activities were not predetermined by the moderator to encourage students to spearhead ideas, as student leaders can exert positive

influence on their peers.[88,89,91,92] Instead, the moderator offered a variety of ideas for Veggie Leaders to choose from if needed, and provided gentle guidance to ensure their materials were informative and targeted key messages. Activities completed by Veggie Leaders included:

- Weekly morning announcements: Each week, the Veggie Leaders wrote a brief announcement to convey a simple message from their lesson, beginning with a simple vegetable-themed exercise or stretching activity, and their principal invited 1-2 of the Veggie Leaders to read it to the school during the regular daily announcements. Veggie Leaders had the idea to incorporate an exercise (which loosely revolved around a fruit and vegetable theme), believing that a coordinated activity would prompt students throughout the school to direct their attention to their announcement that followed. One example exercise was "Pretend that you are a farmer planting seeds – slowly bend forward to touch the ground where you plant your seeds, then stand up, reach your arms up over your head, and look up to see if the sun is shining to make your plants grow." The remainder of the announcement was intended to highlight a new topic of posters in the cafeteria or introduce an idea. For example, one week Veggie Leaders introduced the idea of thinking about hunger cues before lunch, saying, "Did you know your belly tells you things that help you know what you might like to eat today? It takes practice, but if you pay attention, you can figure out what it's saying. Sometimes when you notice that your belly is hungry, healthy foods like fruit and vegetables taste better. Try to think about how hungry you are before lunch today!"

- Mindful eating contests: During the intervention, Veggie Leaders planned a 3-part contest for their school (though not a true "contest" as all students who participated received a prize.) Similar to the reasoning for requiring Veggie Leaders to complete an application to enroll in the club, the word "contest" was used to make these mindful eating activities seem exciting for students, hopefully increasing their engagement and participation. Veggie Leaders created a decorative display for the area where students congregate when waiting to enter their lunchroom to hold blank worksheets and a box for those that were completed. Worksheets were adapted versions of those they used during mindful eating lessons and covered exploring sensory aspects of food, learning hunger and fullness cues, and writing a letter to express appreciation for food you receive. The Veggie Leaders edited the worksheets after completing each themselves, announced the contest and due date during announcements, collected completed worksheets, and distributed prizes (*FTTF* t-shirts) during lunch. Approximately 35 students in kindergarten – 5th grade participated in the contest.
- Cafeteria artwork: Much of the Veggie Leaders outreach efforts were focused on creating educational artwork in the cafeteria. Among their creations were signs where they listed their favorite vegetable, what they liked best about it, and a health fact about that food; large hunger and fullness scales labeled with feelings someone might experience at various levels; lists of descriptive/non-judgmental words to use when talking about foods; scenes to show different steps in the food supply chain; and descriptions of resources used to produce food.

- Story writing: Veggie Leaders read a story from *Feeding Minds, Fighting Hunger*[61] called "Miguel's Tomatoes," which was written to teach children about steps in the food system. Veggie Leaders expressed interest in sharing the story with young students in the school and decided to write their own version based on their local community. They created it as a PowerPoint presentation with many pictures and few words so it would be appropriate for early readers. Unfortunately, because of complex school scheduling, there was not time for Veggie Leaders to share their story with students in person, but the file was shared with teachers in the school.
- Photojournalism: Working in pairs, Veggie Leaders were provided with inexpensive digital cameras, and took photos throughout their school (before and after school or during homeroom with permission from their teacher) to document examples of food waste at breakfast, healthy foods prepared in the cafeteria, and examples of their school environment that encourage healthy behaviors. The original intention was to create a slideshow to play during lunch, but photos were not of high enough resolution to project on a large screen; instead, this activity was a learning experience for Veggie Leaders to understand how the environment supports or undermines healthy behaviors and provided a conversation starter for them to teach their classmates about plate waste, why it is important to consider, and how they can minimize it while having breakfast in their classrooms.
- Health fair volunteering: The school's wellness committee organizes a yearly health fair and Veggie Leaders created and volunteered at a food waste-oriented table. They decorated the table with annotated food recovery hierarchy diagrams

and, during the fair, created an interactive display to solicit ideas to create less waste at lunch. They posed a question on a poster board ("what are ways that you can throw away less healthy food at lunch?") and asked students and their parents to write ideas on post-it notes. Additionally, they distributed printed information to parents about ways to reduce waste at home.

These activities target constructs at both the environmental (disseminated messages throughout the school community) and behavioral (modeling & teaching of eco-literate behaviors, development of mindful eating skills) levels.

3.4.3 Cafeteria Environment Strategies

Because the school environment has influence on student food consumption,[112] *FTTF* incorporated strategies to reinforce messages in the cafeteria, which were designed to draw attention to daily produce options and encourage engagement. Colorful graphics used on signs and materials **(Figure 2)** were designed based on feedback during the formative study, where students indicated simple, colorful images showing children were the most eye-catching. Research indicates consistent branding is an effective method to increase attractiveness of healthy options[113] and project visibility.[114,115]

***Figure 2**: FTTF photos showing program branding*

Cafeteria reinforcements included a menu board specifically to highlight fruits and vegetables of the day, labeling items in the tray line, and a feedback board. While the schools in the district routinely send home monthly menus and announce options each morning, menus in the cafeteria were observed during the formative study to be inconsistently updated and may have prevented students from truly considering which foods they would prefer to eat that day. The new menu board was placed at the entrance to the cafeteria, where students congregate before being sent in for lunch, adding an additional opportunity to emphasize daily fruit and vegetable options and encouraging students to use mindfulness skills by considering their preference before selecting food.

Labeling foods in the tray line is a common technique to inform students of the available options and recommended as part of SL interventions but was not previously done in this school system. Formative research indicated students could not see available foods, causing them to perceive few available choices, so a simple cafeteria change was

to begin writing available foods on the glass sneeze-guard in the service area tray lines. These strategies offer opportunities for students to consider available choices, highlight their autonomy, and encourage practicing mindful eating by considering which satisfies their hunger, preferences, and physical cues.

The feedback board was a large, durable poster displayed in the cafeteria. Each week, a question specific to that week's lesson was posted (e.g., "What are ways you notice when you are hungry or full?" or "What is your favorite vegetable and what do you like about it?"), with provision of blank note cards, pencils, and a receptacle for completed cards below. The previous question and student responses were taped to the wall in nearby space. This strategy was intended to help further disseminate messages throughout the school (environment construct) by encouraging students to consider concepts throughout the week. Additionally, formative feedback indicated students were excited to see their work displayed publicly, so this practice was further thought to increase overall engagement.

Finally, a food recovery program was established in the cafeteria to target environmental and behavioral level constructs. Many schools utilize share bins/tables for students to donate unopened and intact items, like milk or bagged carrots, that they do not want and is a recommended method to reduce food waste.[116] Donated items are then freely available to any student. Guidelines[117] state that recovered items may be offered during a subsequent meal service or donated to an outside non-profit organization, but formative findings revealed food safety concerns led schools to dispose of them or remove share bins entirely. The intervention school had used a small share bin the

previous year but discontinued it due to low use by students and concerns about germs. The control school had a small bin that was maintained throughout the intervention.

As part of *FTTF*'s pilot implementation, an expanded share table was created, steps were taken to ensure items remain food safe, and the school was consulted to determine an appropriate use for recovered items. The researcher explored opportunities to donate items to a local emergency food program, but logistically, it was not a feasible option for the pilot study. It was decided that the best recipient was the intervention school's afterschool program, as the cafeteria manager explained that a higher proportion of attendees qualify for free or reduced-price meals than the school's general population, and many are also recipients of the school's backpack pantry program. The backpack pantry is a program to distribute shelf-stable items at the end of the week to students who may experience hunger over the weekend; this program was also considered as a target for food recovered in the cafeteria, but distributing perishable items to students who rode the school bus or did not go directly home after school was a barrier to implementation. Instead, utilization of the backpack pantry program was thought of as a marker to identify an appropriate group to be offered donated food items.

The share table was designed to be attractive, using a brightly colored tablecloth, labeled bins, and a banner to indicate the table's purpose (**Figure 3**). Rules protecting food safety were introduced to students when the table was first established, and protocols were reinforced by cafeteria monitors. Specifically, the researcher introduced the table to students, explained that only sealed or intact items (e.g. unbitten whole fruit) that were served by the cafeteria could be donated, showed where items should be placed, and explained that students should not donate items when they were feeling sick.

***Figure 3**: Expanded share table photos*

The expanded share table targeted environmental level constructs by creating new options for food recovery. Additionally, it targets the behavioral level by offering an opportunity for students to practice mindful eating and waste reduction skills. In this way, students had an opportunity to select a healthy snack if their hunger level was higher than anticipated or could utilize a more sustainable method to dispose of uneaten food than throwing those items in the trash bins. Finally, because students in the formative study expressed strong interest in reducing waste to help alleviate food insecurity experienced by some members of their community, it offered an opportunity to address their moral concerns about food waste.

3.5 Evaluation & Analysis

3.5.1 Data Collection Instruments & Activities

Measurement tools and activities included in the pilot study measured key outcomes related to produce consumption and plate waste patterns at the individual and school level. Specifically, meal observations were made of student lunches to capture individual selection, consumption, and waste behaviors among kindergarten – 5th grade students; a behavioral survey was administered to 3rd – 5th grade students to measure changes in related psychosocial constructs at the individual level; and plate waste was measured at the school level by conducting a series of food waste audits. These measures are described in more detail below.

Digital photography of student meals: Selection, consumption, and plate waste behaviors among students were measured at the individual level through observing student lunches at the study baseline and conclusion, using the digital photography method of visual estimation. Methodology for taking pre- and post-meal photos was based on procedures described by Taylor and Colleagues,[72] who validated their procedures by comparing visual estimates to a sample of weighed items (n = 164). Specifically, a digital camera was set up on a tripod and a mat with guidelines for tray placement was placed on a rolling cart. This allowed researchers to move the camera station around the cafeteria while ensuring that photos were taken from the same height and angle. Researchers took pre-meal photos of student lunches as soon as students exited the tray line and before they began eating. Post-meal photos were then taken by collecting trays from students prior to them discarding the contents and performing minimal adjustments to ensure that all remaining food items were visible (for example,

by removing napkins or wrappers, or by pouring the contents of a chip bag onto the tray.) Additionally, researchers removed items that were not visually estimable, such as milk or juice served in opaque containers. These items were labeled with the student's ID number and weighed separately.

Following data collection, PowerPoint presentations were created to present pre- and post-meal photos side-by-side. These photos were each evaluated by two research assistants, who recorded all foods selected by the student and rated the proportion consumed of each component on the tray using a modified Comstock rating scale[72,74] where the proportion eaten was estimated as none (0%), taste (10%), some (25%), half (50%), most (75%), or all (100%). Weights of non-visual items were then used to calculate the proportion consumed (based on the weight of the unopened item), which was added to the dataset. Any ratings by the research assistants that differed by >1 point on the 6-point rating scale were reviewed and adjudicated by the lead researcher to reach a consensus. Approximately 89.4% of the initial ratings made by the two research assistants were in agreement.

Some photos were due to unfamiliarity with the camera equipment or because students accidentally discarded their tray contents before it was collected. Observations that were missing pre-meal photographs were removed from the dataset. It would have been possible to estimate the proportion consumed of any items that the student did not finish from these photos, but doing so would have resulted in underestimation of intake because any items that were completely finished could not be recorded by researchers as part of the list of selected foods. This resulted in the removal of 37 photos from the baseline dataset and one photo form the follow-up dataset. When the student's post-meal

photo was missing, as was the case for 8.3% of the observed meals, the mean value for the proportion consumed by students within the same school was imputed for all selected items. A more conservative approach would have been to assume that these students consumed 100% of all selected items, but this would have overestimated consumption. Because these missing observations were due to camera errors on the part of the researchers and not because of student characteristics, it was decided that using the mean value would reduce the chance of overestimating intake without introducing a dramatic source of bias.

Standard serving sizes for foods were obtained from production records and verified by weighing 2-3 samples of each food at baseline. These values were used in the evaluation of the nutritional content of foods selected, consumed, and wasted by each student. Nutrient analyses and meal crediting information of foods served were provided by the county's registered dietitian; when values for certain nutrients were not available, they were collected from the manufacturer (for packaged items) or from the USDA's Standard Reference (for non-packaged items such as fresh fruits or vegetables.)[118] Combined with serving sizes and the proportion of each item consumed, these data allowed the estimation of servings of fruits and vegetables, energy, and macro/micronutrient content of foods that students selected, consumed, and discarded at lunch.

The same classes were observed at both time points, but only students who ate a school lunch on the data collection day were eligible to participate. As stated, variations in student purchasing and attendance led to samples at baseline and follow-up that differed somewhat, resulting in 235 students participating at baseline (69.8% at the

intervention school, 30.2% at the control school) and 253 students participating at follow-up (68.4% at the intervention school, 31.6% at the control school); 162 of these students participated in both measurements (75.3% at the intervention school, 24.7% at the control school). Sample sizes for all activities are summarized in **Table 1**. Student lunch observations were made over a period of 3 days at each school so that a variety of menu items could be evaluated. The school system uses a modified two-week cycle menu, where entrees repeat biweekly and side items repeat weekly. Because the main emphasis in this implementation was to observe changes in student produce intake, observations at the two school were separated by one week to balance the need to observe comparable foods with parameters in the school schedule (such as half days and field trips) that were expected to affect student attendance and lunchtime consumption.

A set of 30 identification numbers was given to each class that agreed to participate and teachers were asked to assign each student an ID number, which was tracked on a list with the students' first names only. Each participant's meal was identified in the photos by placing a laminated card with their ID number on the student's tray and students used the same numbers at both measurements. The researcher kept the ID list and set of cards for each class in a sealed envelope during the implementation period.

Individual psychosocial measurement: The participating 3rd – 5th grade classes were also asked to complete a behavioral survey to capture information about their produce intake during the previous day and changes in psychosocial factors related to mindful and sustainable eating at both baseline and follow-up periods. Four dietary intake questions were selected from the CATCH Kid's Club After-School Student

Questionnaire,[119] an instrument previously tested in this age range. Previous psychometric analysis showed items in this original questionnaire to have acceptable reliability (Cronbach's $\alpha > 0.6$ throughout the instrument); recognizing that self-reported intake of students is problematic to measure, this level of reliability was considered reasonable. The selected items asked the student to report the number of times they consumed fries/chips, vegetables, beans, and fruit during the previous day, with options ranging from "none" to "three or more times." Because produce consumption was of primary interest in the present study, the questions asking about vegetable, bean, and fruit consumption were used in the analysis. A composite score to estimate number of produce eating occasions during the previous day by summing responses to the three items (and making the assumption that three was the maximum number of times students consumed any of the individual categories in one day); the range of possible responses to this composite variable was 0 – 9.

The remaining questions were adapted from a more general eating behavior survey that was designed for use in young adolescents to measure changes in SCT-related constructs.[48] These items were adapted to more specifically ask about mindfulness- and sustainability-related behaviors and can be seen in **Table 7**. The original instrument included subscales for 7 SCT constructs: self-efficacy (belief in one's ability to achieve the desired behavior), intentions (proximal goals set by an individual), behavioral strategies (methods used to increase motivation or help achieve proximal goals), expectations (perceived benefits), perceived importance (value placed on perceived benefits), situation (perception of environmental influences), and social norms. The original instrument showed acceptable internal consistency ($\alpha = 0.65 – 0.79$ for all

subscales) and excellent rank order repeatability (intraclass correlation coefficient [ICC] = 0.81 – 0.89 for all subscales).[48] Confirmatory factor analysis was used to demonstrate factorial validity of the instrument, and the finalized instrument demonstrated adequate to excellent model fit for all subscales of the SCT model.[48]

Formative feedback indicated the need for any survey instruments to be short and quick for students to complete; for this reason, along with evidence from a previous mediation analysis[51] that showed less evidence for social support and situation constructs in predicting behavior of this age group, items from these subscales were removed to create an abbreviated instrument. Additionally, wording of the included items was adjusted to more specifically probe about mindful eating and the environmental impact of food choices, rather than about eating behaviors in general.

Responses to items in each subscale were averaged to create composite estimates of self-efficacy to base lunch choices on body cues, intentions to select and eat healthy foods, behavioral strategies employed to practice mindful and sustainable behaviors, expectations of health benefits resulting from mindful and sustainable behaviors, and importance of experiencing those expected benefits that were on the same scale as the individual items. As seen in **Table 7**, possible responses for self-efficacy and expectations ranged from 1-6, from 1-5 for behavioral strategies, and from 1-4 for intentions and importance.

Prior to administration, the instrument was reviewed with subject-matter experts to ensure content validity and pilot tested with a group of 50 3rd-5th grade students to ensure the questions were understandable and of an appropriate reading level. Reliability of the adapted instrument was then evaluated by generating estimates of internal

consistency (using Cronbach's α), repeatability (using ICC), and stability of repeat administrations (using Spearman's ρ). Unacceptable reliability results were used to identify possible items for removal (for example, if removal of an item substantively improved internal consistency of the subscale, researchers considered dropping that item from the subscale.) The researchers used the same benchmarks for acceptable reliability used by Dewar, et al.;[48] however, this goal was balanced with the need to maintain at least three items in each subscale to create a composite variable and recognition that results from this pilot implementation would be used to refine the instrument for future work. As a result of reliability analyses, two self-efficacy items (SE to understand hunger, and SE to eat with friends) and one from behavioral strategies (considering hunger when choosing food) were removed for the main analysis.

Students used the same ID numbers when completing the survey as they did during the plate waste measurement, and any student who did not participate in that activity were assigned a new number. All students in the participating classes were eligible to complete the survey, including students who do not regularly eat a school-provided lunch.

***Table 7**: Mindful and sustainable eating questionnaire items*

Domain	Item	Responses
Food Frequency Questionnaire	1. Yesterday, did you eat French fries or chips? Chips are potato chips, tortilla chips, cheetos, corn chips, or other snack chips. 2. Yesterday, did you eat any vegetables? Vegetables are salads; boiled, baked and mashed potatoes; and all cooked and uncooked vegetables. Do not count French fries or chips. 3. Yesterday, did you eat beans such as pinto beans, baked beans, kidney beans, refried beans, or pork and beans? Do not count green beans. 4. Yesterday, did you eat fruit? Do not count fruit juice.	• No, I didn't eat any yesterday. • Yes, I ate it 1 time yesterday. • Yes, I ate it 2 times yesterday. • Yes, I ate it 3 or more times yesterday.
Self-efficacy to base lunch choices on body cues *When I eat lunch at school…*	1. …I find it difficult to know how much food I am hungry for. 2. …I find it easy to notice when I am starting to get full. 3. …I believe I can decide how much food is the right amount for me. 4. …I find it difficult to eat an amount of food that's right for me when I eat with my friends. 5. …I find it easy to finish my fruit. 6. …I find it easy to finish my vegetable.	• Disagree a lot • Disagree • Disagree a little • Agree a little • Agree • Agree a lot
Intentions to select and eat healthy foods *In the next three months do you…*	1. …intend to finish your fruit at lunch? 2. …intend to finish your vegetable at lunch? 3. …intend to think about how hungry you are before eating lunch? 4. …intend to think about how the foods you eat help or hurt the Earth?	• Not at all true of me • Mostly not true of me • A little true of me • Very true of me
Behavioral strategies employed to practice mindful and sustainable behaviors *In the past three months did you…*	1. …think about how hungry you were before choosing food at lunch? 2. …think about where your food came from? 3. …try to focus on eating during lunch so you would have time to finish? 4. …think about whether the foods you chose were good for you?	• Never • Rarely • Sometimes • Often • Always
Expectations of health benefits resulting from mindful and sustainable behaviors *Please indicate how much you agree or disagree with each statement.*	1. Thinking about how hungry I am can help me eat healthier. 2. My body gives me cues that help me decide what to eat. 3. Understanding where food comes from (how it is grown, produced, or made) helps me eat healthier.	• Disagree a lot • Disagree • Disagree a little • Agree a little • Agree • Agree a lot
Importance of experiencing expected benefits *Please indicate how important each statement is to you.*	1. How important is eating healthier to you? 2. How important is listening to your body cues to you? 3. How important is understanding where food comes from to you?	• Not at all important • Only a little important • Important • Very important

Domain	Item	Responses
Food Frequency Questionnaire	1. Yesterday, did you eat French fries or chips? Chips are potato chips, tortilla	• No, I didn't eat any

School-wide plate waste measurement: Plate waste was also measured at the school-level by conducting a series of food waste audits using a methodology suggested by the USDA and EPA.[120] Audits were conducted four times at each school – at baseline, follow up, and two evenly spaced periods during implementation – and were held on days when the schools served the same menu. Because of space and time constraints, lunch trays were collected from 2-3 classes in each grade at the end of their lunch period during 7 out of 8 measurements (an attempt was made during the 1st measurement to include the entire school, which was deemed not feasible during the remaining measurements.) The items remaining on student trays were then separated by data collectors into buckets labeled for meat/meat alternate, grains, dairy, fruit, vegetables, and snacks/a la carte items. Inedible items (such as cores, peels, napkins, and straws) were discarded into the trash. After the items collected from an individual grade were sorted, the buckets were weighed and the number of trays was counted to determine average per-student estimates of plate waste in each category.

3.5.2 Data Management

All data collection materials (focus group and interview recordings, transcripts, and notes, observation notes, meal photographs, completed questionnaires) and completed consent forms were securely stored. Physical materials (notes, questionnaires, and consent forms) were maintained in a locked private office. Electronic materials have been maintained on a password protected computer and shared amongst the research team using a secure network. Collected data included only the ID number of participants; identifying information, such as full names or birthdates, were not recorded on any data

collection forms. Similarly, signed consent forms have no record of participant ID numbers linked to them.

Data entry methods were specific to the type of data collected. Recordings of focus groups and interviews were processed by the researcher to develop verbatim transcripts. Behavioral questionnaires were entered by research assistants and checked for errors by the lead researcher. Individual plate waste data were independently evaluated and entered by two research assistants. The lead researcher then created macros in Excel to compare their evaluations, which flagged all differences, and reviewed these with the original meal observation photos to correct any errors (e.g. missing or mislabeled foods) and to adjudicate ratings that were not within one point on the 6-point rating scale.

Initial processing of data was conducted in Microsoft Office. Transcripts of interviews and focus groups were created in Word and, using the method proposed by Ose,[121] were transferred to Excel for coding and sorting into a logical structure, before transferring back to Word for later analysis. Meal observation photos were organized in PowerPoint, so that each slide included the pre- and post-meal photos from an individual student. Additional cleaning and preparation of data was conducted in Excel, by flagging values that were outside of possible response ranges, creating codebooks, and organizing into structures suitable for analysis.

3.5.3 Data Analysis

Analysis of qualitative data from the formative was guided by grounded theory, specifically using the constant comparative method.[54] Grounded theory provides a useful framework for conducting and analyzing qualitative research, where data are analyzed

without a pre-defined hypothesis in mind; instead, themes and concepts emerge organically during evaluation of the data to develop hypotheses that are setting-specific and appropriate for further investigation in the population of interest.[52] Incorporating the constant comparative approach offers a method for data reduction through the process of coding data into discrete categories while continually comparing those categories based on their conceptual content.[54] Taken together, these data collection and analytical practices are important to justify the underlying basis and methods to be used in a later intervention study.[55] Coding and sorting of transcripts, as described in the data management section, allowed data to be structured by key themes that emerged organically.[121] Key themes for each method (observations, interviews, and focus groups) were summarized by the frequency and strength of comments and then compared to highlight similarities and differences among findings from each perspective.

All analyses of quantitative data were completed in SPSS version 24. Records of selected foods were adjusted for items donated to or taken from the share table. Estimates of foods selected and the corresponding proportion consumed at the individual level yielded estimates of the amount consumed and wasted of each item. Selection, consumption, and waste estimates were then combined with nutrition and meal crediting information as previously described. Values measured at baseline and follow-up were used to compute change values for each food group serving or nutrient category by subtracting the baseline value from the follow-up value. Change values for the intervention and control schools were then compared using independent samples t-tests to identify values indicative of significant between group differences. In addition, output of Levene's test was reviewed for each comparison; when unequal variances were present

among the two samples, the nonparametric alternative was used for significance testing. Paired samples t-tests were also conducted to identify significant within group differences from baseline to follow-up at both schools.

The survey results were handled similarly but analyzed with non-parametric alternatives due to the categorical nature. Between group differences were tested using the Mann Whitney U test for independent samples. Within group differences were then evaluated using the Wilcoxon Rank-Sum test to identify significant changes over time.

Composite variables from the behavioral survey were then used to assess any apparent associations with selection, consumption, and waste estimates. Psychosocial composite variables were examined as possible predictors of fruit or vegetable selection, consumption, and waste by students in linear regression models. Using backwards selection methods, all psychosocial variables (the 5 SCT constructs and composite variable estimating the number of produce eating occasions on the previous day) were included, along with treatment group (intervention vs. control school) and grade level. In addition, when models to explain consumption of fruit or vegetables were created, the number of fruit or vegetable servings selected and the number of calories consumed were included as control variables. Similarly, when the number of fruit or vegetable servings wasted was examined in regression analysis, the number of fruit or vegetable servings selected was included as a control. Only variables that were significant in predicting fruit or vegetable selection, consumption, or waste were retained in the final models. The amount of variance explained (R^2) was evaluated as an indication of the ability of the model to predict student behaviors.

School-wide plate waste was summarized as per-student estimates for each food group. Additional data, such as student demographics and data obtained from share table tracking, were summarized with means, frequencies, and percentages.

CHAPTER 4: FORMATIVE RESEARCH FOR A NUTRITION INTERVENTION TO REDUCE PLATE WASTE AND IMPROVE FRESH PRODUCE INTAKE IN SCHOOLS

4.2 Introduction

To promote children's healthy physical, emotional, and educational development,[6] NSLP is dedicated to provide balanced meals to improve diet quality and promote food security.[2] Recent studies of NSLP showed rates of plate waste as 14-31% of food served, the highest amount resulting from vegetables.[3] Waste of healthy food threatens the ability of schools to achieve nutrition goals. Further, wasted food, including the proportion resulting from plate waste, threatens food system sustainability.[19] Therefore, the reduction of plate waste should be a priority on the emerging public health agenda. Emphasizing sustainability in nutrition interventions is a possible strategy to nutritional and environmental consequences of waste.

Most research cites neophobia, low hunger at meal time, preferences, limited time to eat, and food quality as drivers of plate waste.[15,31,36] A qualitative study of underlying factors of food waste attributed waste to three areas: food-related (e.g. difficulty consuming certain foods), child-related (e.g. taste preferences), and program-related, including foodservice policies.[24] While research has outlined reasonable determinants of plate waste, primary focuses of existing studies were to assess meal acceptability by

estimating waste, as opposed to identifying causes.[31,36] Additional examination is necessary to identify strategies to reduce food waste among children to support healthful eating and sustainable practices in school cafeterias.

Mindful eating is a practice to focus on how eating affects an individual and is achieved by directing attention on how physiologic needs, emotions, and external cues impact food choices.[99–101] Previous research found mindful eating may improve student preferences for fruits and vegetables.[58] Expanding understanding of mindful eating to emphasize relationships among food choices and sustainability[100] offers a framework to influence student fruit and vegetable intake and encourage consideration of environmental implications of waste, presenting an opportunity to balance waste reduction and child nutrition goals.

The purpose of this study was to conduct formative research in public elementary schools to 1) understand how students and school staff perceive plate waste and sustainability, 2) examine determinants of waste and related barriers/facilitators, and 3) explore school-based mindfulness and sustainability approaches to reduce waste.

4.3 Methods

This study was conducted in spring 2018 at three public elementary schools in MD. The proportion of students who are FARM-eligible is over 50% and participation is approximately 60%. Reflecting the importance of community engagement, schools were selected based on advice of the foodservice supervisor, who has built long-term partnerships with the local schools, and three of the five elementary schools were asked to participate.

Students were eligible for focus groups if they were in 3rd-5th grade and a parent provided written informed consent. A recruitment letter describing the study was distributed with the parental consent form by principals to approximately 60 students at each school. Students were offered a small gift for participating.

Staff were recruited for the interviews by snowball sampling. Initially, school principals were invited, who then recommended additional participants. Interviewees provided written informed consent and were eligible if they worked in the cafeteria or had knowledge of lunch behaviors. Fifteen staff members participated.

4.3.1 Conceptual Framework & Assessments

Development of assessments was guided by SCT, a framework commonly used when designing health promoting interventions in this population.[40] Potential constructs in three factors were considered when planning assessments: personal/cognitive (knowledge of the food system and nutrition, attitudes and preferences related to food and food waste), behavioral (waste and consumption patterns, motivators and barriers related to those behaviors), and environment (available food, social norms, and disseminated messages throughout the school community).

Activities included focus groups, semi-structured interviews, and cafeteria observations. While the main emphasis was on understanding students' perspectives, it was believed that feedback from school staff and cafeteria observations would complement focus group findings.

Cafeteria observations: Three lunch periods at each school were observed to understand environmental factors that may influence consumption and waste patterns. An

adapted version of a structured cafeteria observation form[64] was used to evaluate general layout/flow, available foods, foodservice practices, and interaction among adults and students. Additional attention was focused on observing lunchroom turnover practices, how students discarded remaining food, and which foods were commonly discarded.

Focus groups: 5 focus groups with 3rd – 5th grade students (n = 50) were held during the school day. Students were asked about concepts related to nutrition, mindful eating, and sustainability, and their opinions about the amount and types of foods often wasted, both in general and in the school environment. Finally, they were asked several questions to gauge interest in a future intervention.

In-depth interviews: 15 interviews with school nutrition personnel, administrators, and other staff members were conducted. During the interviews, staff were asked to discuss opinions regarding student eating and food waste behaviors and perceptions of barriers or facilitators to behavior change. Food service staff and administrators were asked logistical questions related to meal service. Finally, interviewees were asked opinions about various possible program strategies.

Interview and focus group guides were developed using triangulated methodology to solicit feedback in key areas (outlined in **Table 8**) and converge different information sources**.** The study examined 1) student knowledge/perceptions of healthy diet, mindful eating, and sustainability, 2) perceived causes/magnitude of plate waste, and 3) possible school-based strategies to reduce waste and encourage healthy eating. Photos were used as prompts for focus groups to ensure questions were understandable. Materials for all activities were reviewed with subject experts to ensure content validity. Field notes, audio

recordings of interviews and focus groups, and verbatim transcripts were generated. This study received Institutional Review Board approval prior to beginning.

***Table 8**: Key topic areas of focus group and interview discussions*

Theme	Sub-themes	Sample Questions
Student knowledge/ perceptions of healthy diet, *ME, sustainability	- Definition of healthy eating - Concept of ME - Perceptions of food waste & sustainability	*FG: "What makes it harder or easier to know when you are hungry or full?" *I: "What do your students learn about nutrition in school?"
Perceived causes/ magnitude of plate waste	- Causes - Magnitude, types of foods wasted - Related problems	FG: "Why do kids throw away food at lunch?" I: "Do you think the amount of food that students throw away is problematic?"
School-based strategies to reduce waste/encourage healthy eating	- Current strategies to reduce waste - Future strategies and interest - Logistics	FG: "What activities would make it fun to learn about food?" I: "If I addressed barriers you described, how can I make this program successful?"

*ME: Mindful eating; FG: Focus Group; I: Interview

4.3.2 Analysis

Analysis was guided by Grounded Theory, specifically using the Constant Comparative Method.[54] In Grounded Theory, data are analyzed without a pre-defined hypothesis; instead, themes emerge during evaluation to develop setting-specific hypotheses.[52] The Constant Comparative approach offers a method for data reduction through coding into discrete categories which are continually compared based on conceptual content.[54] Together, these practices justify methods for future interventions.

4.4 Results

4.4.1 General Cafeteria Environment

Nine cafeteria observations were conducted in the three elementary schools (three observations per school) in April – June 2018. In general, cafeterias were noisy and active during lunchtime, but all ran efficiently and students moved through lines quickly.

Menu boards and foods offered: All three schools had large menus mounted in the cafeteria to display the current and following days' menus, although they were inconsistently updated, occasionally displaying options from the previous day. Schools served a wide variety of fruits and vegetables during every observation; on any given day, schools generally offered two hot vegetables, salads, raw vegetables, and a selection of whole, cupped, and dried fruit. Produce was offered in multiple locations and was consistently observed to be high quality. Menu items were not labeled on the tray line.

OVS: OVS is a practice where students select at least 3 of 5 components offered, one of which must be a fruit or vegetable, when purchasing a reimbursable meal and its use is associated with reduced plate waste.[3] Observed schools utilize a modified version of OVS in the cafeterias, where students are required to select a fruit, may select milk, and are served a half portion of the vegetable of the day but may ask for a full portion.

Use of share bins: Two of the observed schools maintain share bins in the cafeterias; neither was labeled, but the purpose was apparent. Students used bins to leave unopened items (e.g. milk, packets of carrots) and whole fruit in ice-filled bins, where donated items are then available for any other student to take. Items remaining at the end of the day's lunch periods are then discarded. The share bins rarely contained more than a dozen items during observations.

Interaction among adults and students: Cafeteria monitors and administrators supervised lunch in all schools. Their interaction with students was generally limited to behavioral oversight. They provided some assistance to young students by opening packages or offering condiments and were infrequently heard encouraging students to eat items on their trays, like fruits or vegetables. When adults ate in the cafeteria, the adults present were most often observed eating a la carte foods from the cafeteria or outside items like soda or coffee while walking around the room. No teachers or staff were observed eating with students, except for a table dedicated for students in the special education program.

Lunchroom turnover practices: Lunch waves at each school were 30 minutes, with a 5-10-minute gap before a new group used the same set of tables. Lunch waves were staggered in such a way that lunchtimes for older and younger grades alternated and overlapped by 10-15 minutes (for example, in one school, 2nd grade ate from 11-11:30, 4th grade ate from 11:15-11:45, and 1st grade ate from 11:35-12:05). No schools separated recyclable materials. In the brief period after one wave of students returned to their classrooms and before the next wave arrived, monitors and custodians worked quickly to clean the area, wiping down the tables and benches, sweeping the floor, and switching full trashcans for empty ones. While observations did not allow an opportunity to measure amounts of plate waste produced by students, it appeared that students frequently discarded unopened and/or untouched items in trash cans, even at schools with share bins.

4.4.2 Participant Demographics

Five focus groups were conducted, with 50 total participants; among them, 44% were in 5th grade (n = 22), 34% were in 4th grade (n = 17), and 22% were in 3rd grade (n = 11). The majority (72%, n = 36) purchased school lunch at least occasionally; among these students, 53% (n = 19) bought lunch daily. Fifteen adults participated in interviews including: 6 foodservice personnel, 5 administrators, 3 wellness chairpersons, and 1 custodian. The majority (13) worked at the schools and two had supervisory roles in the county foodservice department.

4.4.3 Thematic Findings from Focus Groups and Interviews

Theme 1: Student knowledge and perceptions of healthy eating, mindfulness, and sustainability

In general, no clear differences were apparent among students of different grades. Students in focus groups demonstrated understanding of simple nutrition concepts; when asked to define "healthy diet," students in all groups were able to identify foods included in a balanced diet, for example *"…healthy eating is basically like you eat fruits, vegetables, and… you rarely have sweets. You don't have them, like every single night."* Students were less able to describe amounts of food that they believed constituted a healthy diet without prompting. When asked if people need the same amount of food every day, almost all responded that most people have varying needs, with reasons including: level of activity, growth, or illnesses. *"One day you might be really hungry…and another day…they'll just eat a little bit just to keep…their belly full."*

As a follow up, students were asked how they know how much food they need on a given day. In response, nearly all students reported using some form of external standard (e.g., looking at the calories on a package, or trusting that their parents serve the right amount,) and made statements such as *"You can tell by, like, how many…calories, I guess?"* Only one student reported listening to his body cues, *"…I think you should eat as much as your body tells you to eat."*

When staff were asked if they believed that students received enough nutrition education in school, all agreed that it is insufficient but most felt it infeasible to add to the curriculum, *"I think that we are more consumed with teaching reading and writing than we are food… I think we do what we are required to do and what we can do…knowing all the other things that we're expected to teach."*

No students were familiar with the term "mindful eating," although some were able to explain related concepts. When asked to describe hunger and fullness, students frequently discussed extreme sensations, using words like "pain" and "dizzy" for hunger and "cramping" and "feel like [you're] going to explode" for fullness. Students did not describe sensations of slight hunger or fullness without prompting, but some responded to prompts by saying that slight hunger is more related to emotions than physical feelings. Most students agreed that it is easy for them to notice when they are very hungry or full but more difficult to notice when they are only slightly hungry or full.

Several students reported being forced to eat at a given time, like during scheduled lunch times, makes it more difficult to eat according to hunger and fullness cues. They generally did not believe cafeteria distractions disrupted hunger and fullness cues but reported that excessive noise makes them difficult to notice.

Students were also asked questions about how the food that people choose, eat, and/or discard is related to the environment. While nearly all agreed that food waste is bad for the environment, most were only able to discuss the effect of littering: *"…sometimes if you throw away a big amount of food that shouldn't belong [in the trash], it would overflow the trash cans, and…would blow everywhere."* Only one student spoke broadly on the effect of food production, saying *"…healthy food is either grown on trees or in the ground… junk food and stuff, it's factory made…factories pollute the air and there's a lot of [pollution], because that's what lots of people like to eat."* Overall, students seem to have limited knowledge about the food system's relationships with the environment. Staff confirmed this, explaining that the food system is not a focus of the science curriculum.

Theme 2: Perceived causes and magnitude of plate waste

A summary of perceived causes and magnitude of plate waste produced in schools, along with findings from broader discussions on food waste produced in general, is summarized in **Table 9** and will be described in more detail in this section.

***Table 9**: Perceived patterns, causes, and outcomes of food waste reported in focus groups and interviews*

Topic	Focus group findings	Interview findings
Food waste patterns	- Believe all students throw away too much food, but amounts vary depending on the day - Consistently reported that vegetables are wasted most often	- Report younger students throw away more food than older students - All agree that vegetables are the food group wasted most often
Causes of food waste	- In general, student believe food waste is caused by: o Food preferences and not liking a food served o Lack of awareness or concern for the outcomes of food waste o Foods spoiling or expiring o Unavoidable waste (such as apple cores) - In school settings student believe waste is caused by: o General lunchroom distractions and noise level o Perception of poor food quality o Talking/socializing during lunch o Not having enough time to eat o Perception of limited autonomy in selection o Peer influence as an indication of quality o Unwillingness to try foods o Rules and regulations about meals o Unpredictable portion sizes	- Do not think amount of time to eat or quality of foods served contribute to waste - Reported the following as likely causes: o Poor time management by students/use of lunch as a social time o Low hunger due to breakfast in the classroom o Meal service regulations and required portion sizes o Snacks sold in the cafeteria o Dislike of healthy food, pickiness, and neophobia o Different foods served at home
Problems associated with food waste	- Students most often discussed ethical problems related to food insecurity; this was the first issue raised in all groups. - Students also believe wasting food shows a lack of respect and wastes resources related to money, time, and materials. - When asked if food waste has any impact on the environment, most students agreed but were only able to discuss littering as an example.	- Most aware of problems related to food insecurity - Identified that food waste is "wrong" or "wasteful" but did not consistently identify specific outcomes

Participants in interviews and focus groups uniformly reported that vegetables were the food group discarded most often by students and that rates of plate waste are high. From a student, *"sometimes people do eat [vegetables], but usually they're thrown*

away at the end." Staff reiterated this point saying that waste is mainly, *"Healthy foods, for sure."* or *"…they struggle with the vegetables."*

Students and staff reported some overlapping causes of food waste, including preferences, unwillingness to try foods, socializing during lunch, and regulations requiring students to take unwanted foods. Representative comments from students included: *"… they force you to get fruits and vegetables…most of the kids just throw them away"* and *"…you could be talking the whole lunch and then…when lunch ended, you haven't ate anything."*

Staff reiterated several of those same points. Regarding meal service regulations, staff stated, *"I think it's because it's forced upon them… they just don't want it, but yet they have to take it. And that's what we tell them, 'you don't have to eat it, but you have to take it.'"* Despite the constraints imposed by regulations that food service staff reported, staff described efforts to not overserve students food that they expect to be wasted, for example by using their modified approach to OVS. Staff believe this practice benefits students by encouraging autonomy in food selection and increasing exposure to vegetables without excessive waste. When thinking about students' food preferences, many interviewees felt that their pickiness stemmed from foods served at home, *"…[they] are the chicken nugget generation. You know they're eating a lot of that at home so when they come in, that's all they'll eat. So sometimes when there are healthier options, they don't often eat as much."*

Other reported causes differed between the groups. Students reported many perceived causes of waste related to the meal structure service and structure, including not having enough time to eat, not having enough autonomy in their food selection, and

perceiving the food to be poor quality. Representative comments include: *"Maybe the [cafeteria staff] should ask what [the kids] want to eat."* and *"Vegetables at this school are nasty, I don't like them."* Additionally, they stated their consumption patterns are influenced by their peers. For example, one student stated, *"… you want to impress your [friends]…like if your friend doesn't like something…you don't eat it either."*

Staff reported causes that were focused on student behaviors and characteristics, including poor time management on the part of students. According to a principal, *"They could eat in less time than what they have…I think it's a social time."* Several further reported that students purchasing snacks discourages them from eating their meal. According to the foodservice supervisor, *"I'd like kids to eat their lunches. If I could get away with not having snacks in the cafeteria completely…I'd do away with them all,"* although she went on to explain that budgetary considerations necessitate schools offer competing foods. Although interviewees uniformly believe serving breakfast at school is beneficial, staff thought it contributed to low hunger, particularly among students with early lunch periods, *"We have the universal breakfast so the kids aren't coming into lunch, I think, starving."*

When asked if/why food waste is problematic, students provided more specific reasons than interviewees. During interviews, staff discussed how food waste is wrong and wasteful, stating for example, *"It's a problem because you're wasting food,"* or *"I just wish there wasn't so much waste."* When they did discuss more specific impacts, they were generally focused on food insecurity, *"…we have a lot of poverty in [our county] …if we're losing that amount of food every day then something's not right."*

Students were emphatic about negative moral implications of food waste, and the issue of food insecurity was the first topic raised in all groups. For example, one stated *"…a lot of people don't get food. So, all that stuff that you're throwing away…could be given to people who don't have any food."* Other problems frequently discussed by students focused on the disrespectfulness of throwing away food that people spent time or money preparing, for example, *"…it's not fair to the lunch ladies,"* or *"it would hurt their feelings because they want us to eat it."* Nevertheless, despite their limited knowledge, students demonstrated high interest in addressing negative outcomes of high levels of waste.

Theme 3: School-based strategies to reduce waste and encourage healthy eating

A summary of suggestions made by focus group and interview participants related to encouraging healthy eating and discouraging avoidable waste are presented in **Table 10**, with a more detailed explanation following.

***Table 10**: Barriers, motivating factors, and suggested strategies to reduce waste and encourage healthy eating*

Topic	Focus group findings	Interview findings
Barriers to change	- Students reported that they would enjoy learning about healthy eating and the environment but did not believe their peers would be as interested. - Students have a knowledge of very basic nutrition concepts but have limited understanding of concepts related to mindful eating, the environment, or the food system.	- Programs that detract from the instructional school day will not be well accepted. - Some current misinformation regarding the use of share tables. - Programs that are not well organized with clearly defined objectives, or those that would otherwise detract from staff's necessary job duties, would not be well accepted.
Motivating factors for change	- Students spoke most emphatically about the moral implications of food waste, especially as related to food insecurity, and seemed to have a strong sense of right and wrong. Appealing to them to "do the right thing" may be a motivating strategy.	- Staff report being most motivated by simply helping children. - Report that students are most motivated by rewards that allow them to stand out from their peers (special privileges, branded items, etc.)

Program ideas and strategies	- Programs should demonstrate behaviors and be interactive to make concepts understandable. - Education should be fun (incorporate games or hands-on activities) and visual (by using movies, slide shows, skits, or plays). - Students believe that incorporating challenges and rewards would get the school more excited to participate. - Offering opportunities to try new food would be an enjoyable way to learn about healthy eating.	- Connect with wellness programs to offer points to staff for participation - Utilize older students as role models/student leaders - Meet with students outside of school hours to not detract from instructional day

Interviewees discussed several strategies currently used in the schools that help reduce food waste. Menus used in the cafeterias have been designed to reuse leftovers as appropriate, for example by serving salads with sliced chicken the day after chicken sandwiches are served. Additionally, foodservice staff have been trained some SL strategies, such as nudging or taste testing new menu items, that encourage increased acceptance of produce. SL offers a set of research-based recommendations that encourage healthier choices, often by altering the cafeteria environment to make healthy foods more available and or through marketing techniques that nudge students to select and consume those foods.[10–12]

When exploring strategies during focus groups and interviews, several key factors related to a future program were discussed. As described in Themes 1 (student knowledge and perceptions of healthy eating, mindfulness, and sustainability) and 2 (perceived causes and magnitude of plate waste), students appear motivated by their high interest in moral considerations related to preventing food waste in order to address food insecurity concerns, repeating these points several times throughout the discussions. While their knowledge of nutrition, mindfulness, and food system-related concepts is limited, students agreed they would be interested in learning more about these topics. They were

unsure if their peers would be similarly interested and motivated but felt that they could act as role models to encourage their school community become invested in learning to eat healthier and reduce waste, *"Maybe younger students could see, you know, what the older students do…*W*e could set an example for them, how they should eat or how they should behave."*

When asked about possible program strategies, staff emphasized the importance of meeting with students outside of school hours to not detract from the instructional day, as limited time and resources of schools and teachers are among the biggest logistical barriers, "*…they're busy and they need to make sure that they're not using this time [when] they could be doing something else..."* As suggested during focus groups, staff believed that utilizing older elementary school students as role models would be an effective approach, stating, *"…younger students look up to the older students…like they listen to each other better sometimes than adults."* They further suggested connecting with the school's wellness policy, which schools are required to have to promote student health, well-being, and academic achievement.[122] Connecting with staff members that write and implement the local policy would help ensure that program strategies are sustained after completion.

Students reported several ideas that would be engaging for them, including making sure the program be interactive and fun, "*so [kids] might be able [to] get more into it, but they would also be learning about why it's healthy."* They suggested activities be hands-on, like trying new foods, and that incorporating competitions would be a useful strategy to engage classmates.

4.5 Discussion

Plate waste is a public crisis and adds burden to the NSLP. This study aimed to develop a thorough understanding of determinants of lunchtime behaviors. In particular, the researchers investigated students' perceptions about mindful eating, environmental impact of food waste, and feasibility a program to encourage healthier intake with less waste. Results indicated students and staff believe this is an important area for intervention, as students have high interest but low knowledge. Coupled with cafeteria changes, there appear to be numerous opportunities to encourage increased produce intake and reduced plate waste among students.

Environmental factors noted during cafeteria observations may influence lunchtime food selection, consumption, and waste. While menus are available, inconsistent updating may inhibit students from considering options and result in selecting unappealing foods. Labeling healthy foods and making selection of those foods convenient may encourage higher consumption of fruits and vegetables.[123] Considering that the food environment can exert strong influence on children's intake,[112] efforts to improve the cafeteria may be beneficial. Particularly in districts like the one studied, where high quality and ample variety of food is available, focusing strategies on the cafeteria rather than foodservice may be a more efficient strategy to reduce waste and encourage healthy eating. However, preferences, particularly low for vegetables, and perceptions of poor quality were seen as a driver of plate waste. It would benefit all schools to monitor food quality and solicit feedback with taste tests.

Students were chiefly interested in reducing food waste to reduce food insecurity. Strategies currently employed by schools that target food insecurity could be expanded

and linked to supplemental assistance for lower income students and their families. While evaluation data on food recovery/redistribution efforts within schools are limited, preliminary research shows social and economic benefits.[124] Given high interest voiced by students, highlighting ways that reduced food waste can benefit members of their community who struggle with food insecurity can increase participation.

Foodservice practices could be further investigated to understand their potential to reduce waste. Promoting ways that the foodservice department strives to reduce waste through menu design could increase interest in sustainability efforts. Additionally, SL training for foodservice staff could be expanded to include cafeteria monitors. As influential adults can have a powerful influence on children,[93] monitors could provide effective support for students to improve behaviors, like encouraging them to consider hunger levels before lunch or putting unopened items in share bins rather than the trash.

In general, students have basic understanding of mindful eating concepts but did not consider these when choosing food. When discussing eating behaviors, it was apparent that students intake is unconsciously affected by friends and parents, a finding supported in research.[125] Incorporating family education and peer-leadership in a mindful eating program could make use of social effects to encourage improved behaviors. Considering students' interest in learning about mindful and sustainable eating and motivation to address food waste, a program that provides interactive education and empowers participants to act as role models has potential to be highly successful.

While this study suggests that there is potential for a mindfulness- and sustainability-focused intervention to improve intake while reducing plate waste, results should be interpreted cautiously. As this study was conducted within one district to

design a feasible intervention, findings are not necessarily applicable to other schools. Despite this, the study provides useful information to understand plate waste and replicable methodology for formative research in similar settings. Further, findings are being used to design a pilot intervention that will address the identified key determinants, barriers, and facilitators in order to support healthful eating habits and reduced plate waste. If successful, it will be replicated in broader settings to address the generalizable needs of elementary schools.

4.6 Implications for Research and Practice

Because a key goal of school meals programs is to provide nutritionally balanced meals for students, waste indicates failure to achieve nutritional objectives, threatening healthful development of children. This study highlights opportunities to design a theoretically based program for elementary schools to promote improved consumption while reducing waste. By implementing a program to encourage increased fruit and vegetable consumption through the development of mindful and sustainable behaviors, the results have the potential to positively impact the health and nutritional status of children, school finances, and resources of the community.

CHAPTER 5: DEVELOPMENT OF A SCHOOL-BASED MINDFUL- AND SUSTAINABLE-EATING INTERVENTION TO REDUCE PLATE WASTE AND IMPROVE PRODUCE CONSUMPTION AT LUNCH

5.1 Introduction

Recent estimates of plate waste in schools indicate between 14% and 31% of food served to students is discarded.[3] Highest rates occur for vegetables, dairy, and fruit among elementary school students.[33,34] Because school meals are planned to meet children's needs,[2] excessive waste results in inadequate intake. Additionally, school meals are relied upon most heavily by low-income students, and waste may disproportionately affect the most vulnerable.[32] Further, because food production involves the use of finite resources, waste poses an environmental threat.[19]

The purpose of this article is to describe of *Farm to Tray, Tray to Farm (FTTF*), a newly designed and implemented program that aims to meet child nutrition goals while reducing plate waste at lunch through mindfulness- and sustainability-focused education, peer leadership, and cafeteria changes. Early findings indicate this program is feasible and acceptable, and its implementation has the potential to address important needs of school nutrition programs.

5.2 Previous School-Based Intervention Strategies

Improving diet of schoolchildren has been the focus of extensive research. Various strategies targeting the cafeteria environment appear effective to increase fruits and vegetables (FV) consumption including: increasing variety of FV served, marketing

healthy foods, and making healthy foods easier to obtain.[11,14,123] Effective education strategies, such as observational learning and peer leadership,[93] appear more influential when combined with environmental strategies.[85] Further, policy changes are helpful to sustain healthy changes school-wide.[87] While these techniques were evaluated in nutrition promotion programs, adapting them to target waste reduction could be effective.

Although no interventions have been identified that primarily sought to reduce plate waste in US schools, qualitative studies on related factors recommend possible strategies, including: allowing saving or donating sealed food, serving smaller portions, scheduling lunch later in the day, increasing time to eat, and composting.[15,24,38] Other recommendations to reduce waste target psychosocial factors of students and overlap with nutrition promotion strategies. Specific suggestions address student knowledge, ability, and willingness to consume healthy foods, including actively encouraging consumption of target foods, taste-testing new items, increasing autonomy in selection, offering foods that are easier to eat (e.g. cut vs. whole fruit), providing rewards, and incorporating observational learning opportunities.[15,24,38] Summarily, it appears that cafeteria environment and foodservice policies changes, combined with strategies to target student factors, could simultaneously reduce waste and improve intake.

5.2.1 Mindfulness-Focused Approach is Needed

Emphasizing mindfulness offers an opportunity to encourage improved intake among students with less excess. Mindfulness practice improves self-regulation skills,[99] and studies have demonstrated its potential to encourage healthier food choices.[101] In school settings, general mindfulness strategies have demonstrated benefits positive

changes in social behavior, emotional regulation, and academic performance.[102] A recent mindful eating intervention for elementary students was well-received by parents, educators, and students, and results indicate higher preference for FV.[58] This education program focused on sensory activities, hunger cues, and food exposure, aiming to foster appreciation for the resources to produce food.[59]

Fung and colleagues[100] recommend expanding the conceptualization of mindful eating to also include awareness of food choices' relationships with sustainability and social justice. Using this definition, programs emphasizing mindful eating may positively influence FV intake and encourage students to consider the environmental and social implications of waste that they produce, thus presenting an opportunity to balance waste reduction and nutrition goals.

5.2.2 Concept of Ecoliteracy is Critical

The provision of environmentally-focused education can incorporate sustainability efforts into mindful eating. A useful concept, "ecoliteracy,"[57] provides a perspective for future nutrition and food system interventions. Ecoliteracy is developed when students are encouraged to develop creative strategies to solve complex health and environmental challenges; in doing so, they become engaged and effective leaders of healthy and sustainable communities and ecosystems.[57] When themes of sustainability and social justice are incorporated, encouraging mindful eating is supportive of ecoliterate and healthful behaviors.[59]

5.3 Conceptual Framework of *Farm to Tray, Tray to Farm*

FTTF is an intervention that encourages elementary school students to develop mindful and sustainable eating behaviors. The conceptual framework for *FTTF* draws primarily from Social Cognitive Theory (SCT).[41,43]

SCT is frequently used in youth programs emphasizing nutrition education, behavior change, and the food system.[39,43,46] Research shows evidence that dietary behavior is predicted by important SCT constructs, including: self-efficacy, outcome expectations, knowledge, social support, modeling/observational learning, and availability of food.[43,51] Along with SCT's longstanding use targeting youth behaviors, identification of these constructs supports its selection as the theoretical foundation to encourage development of mindful and sustainable behaviors. The conceptual framework for *FTTF* is shown below in **Figure 1.**

5.4 *Farm to Tray, Tray to Farm* Program

FTTF consists of: (1) education for student leaders to build capacity to increase produce consumption and reduce waste, (2) dissemination of messages by student leaders as a means of peer modeling and building leadership, (3) cafeteria changes to incorporate environmental reinforcements, and (4) development of a food recovery program to provide a new avenue for disposal. Procedures were used during a pilot implementation and were approved by the University of Maryland, College Park Institutional Review Board.

5.4.1 Intervention Strategies

1) Capacity building to increase produce consumption and reduce waste

FTTF's 16-week curriculum aims to increase student capacity to consume produce and reduce waste during lunch. Delivery is intended for Veggie Leaders (VLs), who act as student leaders, during 45-minute weekly meetings. VLs were recruited by distributing a program announcement, application, and parental consent form to 5th grade classes. The application was included to ensure students were interested in the planned topics. A group of 5-15 students is recommended so one adult can facilitate sessions. Lessons were adapted from published resources and intended to target personal level constructs. Lessons are structured into 8 modules, each covered during the first half of meetings over a two-week period. This arrangement offers flexibility to adjust timing as needed and for the VLs to complete tasks between meetings.

The introductory lesson is based on MyPlate. Three lessons, adapted from *Foodie U*, [58,59] are devoted to mindful eating and emphasize sensory exploration of foods, understanding hunger cues, and recognizing the value inherent in food. The remaining lessons, adapted from *FoodSpan*[56] and *Feeding Minds, Fighting Hunger*,[61] focus on understanding the food system from environmental/social perspectives. Food system lessons covered the supply chain, influences on food choices, environmental impact of food waste, and hunger. Lessons were participatory, utilizing activities to convey information and practice new skills. The specific topics, activities, and methods for dissemination are delineated in **Table 11.**

***Table 11**: Overview of curriculum content*

Lesson	Education Activities	Dissemination Activities
Lesson 1: MyPlate	• Matching game for foods/food groups; • Sharing health benefits of favorite FV	• Morning announcement; • Educational artwork for cafeteria
Lesson 2: Exploring our Food System[1]	• Game to visualize connections in food system; • Reading abbreviated version of "Miguel's Tomatoes"[3]	• Morning announcement; • Writing a simplified version of story and creating a presentation for young students
Lesson 3: Sensational Senses [2]	• Creating list of non-judgmental descriptors for food; • Exploring foods using all senses	• Morning announcement; • Prepared materials for contest – adapted worksheet for "Five Senses Snack"
Lesson 4: Why We Eat What We Eat[1]	• Debate on causes of food choices; • Creating artwork to depict "healthy food environment"	• Morning announcement; • Brainstorming ways to adapt cafeteria to encourage healthier choices
Lesson 5: Getting to Know Hunger and Fullness[2]	• Demonstration of hunger and fullness using variety of scales; • Group snack to practice understanding physical sensations	• Morning announcement; • Creation of large hunger/fullness scales for cafeteria; • Prepare materials for contest – adapted worksheet for "Hunger Check Snack"
Lesson 6: Our Wasted Food[1]	• Discussion of food waste generated throughout the supply chain; • Decoration of food recovery hierarchy worksheets for cafeteria	• Morning announcement; • Health fair table - VLs solicited ideas to reduce waste and provided information to parents
Lesson 7: The Hunger Gap[1, 3]	• Discussion of food insecurity; • Journaling activity – students privately wrote/ drew about feelings about community food insecurity	• Morning announcement; • Creation of artwork for cafeteria to promote food recovery
Lesson 8: Planting the Seeds of Mindfulness[2]	• Students started vegetable seeds to demonstrate effort involved in food production; • Mindful eating practice	• Morning announcement; • Prepare materials for contest – adapted version of "Thankful Thoughts" worksheet

[1] Adapted from *FoodSpan* curriculum; simplified for audience age
[2] Adapted from *Foodie U* curriculum; lessons shortened for time constraints
[3] Messages from *Feeding Minds, Fighting Hunger* incorporated into lesson

2) Peer modeling & leadership

The VL's main role is to model behaviors and act as leaders through dissemination activities. Each week, students prepare materials/activities to disseminate concepts covered in that week's lesson to the school during the second half of the meeting time. Activities were not predetermined by the moderator to encourage students

to spearhead ideas, as student leaders can exert positive influence on their peers.[88,92,93] Programs utilizing this model should consider the following options, while encouraging students to develop other creative methods.

Possible dissemination strategies for VLs include: weekly morning announcements to convey messages from that week's lesson, organizing mindful eating contests (where they promote the contest and distribute prizes to students who completed mindful eating exercises at home), creating artwork (educational posters and signs) for the cafeteria, writing stories for young students in the school, photo-documenting examples of food waste in their school, and volunteering at a school health fair. These activities target constructs at both the environmental (disseminated messages throughout the school community) and behavioral (modeling & teaching of eco-literate behaviors, development of mindful eating skills) levels.

3) Environmental reinforcements

Because the school environment has influence on student food consumption,[112] *FTTF* incorporates strategies to reinforce messages in the cafeteria, which are designed to draw attention to daily produce options and encourage engagement. Colorful graphics used on signs and materials **(Figure 2)** were designed based on feedback from a formative assessment, where students indicated simple, colorful images showing children were the eye-catching. Research indicates consistent branding is an effective method to increase attractiveness of healthy options[113] and project visibility.[114,115]

Suggested cafeteria reinforcements include a FV menu board, labeling items in the tray line, and a feedback board. While many schools post daily menus, an additional

FV menu placed where students congregate before lunch provides an additional opportunity to emphasize daily FV options. Labeling foods in the tray line is a common technique to inform students of the available options, and formative research indicated students could not see available foods, causing them to perceive few available choices. These strategies offer opportunities for students to consider available choices, highlight their autonomy, and encourage practicing mindful eating by considering which satisfies their hunger, preferences, and physical cues. The feedback board is a large, durable poster displayed in the cafeteria. Each week, a question specific to that week's lesson is posted (e.g., "What are ways you notice when you are hungry or full?"), with provision of blank cards, pencils, and a receptacle for completed cards. The previous question and responses are posted in nearby space. This helps to further disseminate messages throughout the school (environment construct) by encouraging students to consider concepts throughout the week. Additionally, formative feedback indicated students are excited by seeing their work displayed, so this practice may increase overall engagement.

4) New avenues to reduce waste and recover food

Creation of a food recovery program targets the environmental and behavioral level constructs. Many schools utilize share bins/tables for students to donate unopened and intact items, like milk or bagged carrots, that they do not want and is a recommended method to reduce food waste.[116] Donated items are then freely available to any student. Guidelines[117] state recovered items may be offered during a subsequent meal service or donated to an outside non-profit organization, but formative findings revealed food safety concerns led schools to dispose of them or remove share bins entirely. As part of *FTTF*'s

pilot implementation, an expanded share table was created, steps were taken to ensure items remain food safe, and the school was consulted to determine an appropriate use for recovered items. It was decided that the best recipient was their afterschool program, where a majority of attendees qualify for free or reduced-price meals.

The share table is designed to be attractive, using a brightly colored tablecloth, labeled bins, and a banner to indicate the table's purpose (**Figure 3**). Rules protecting food safety should be introduced to students and protocols reinforced by cafeteria monitors.

Expanded share tables target environmental level constructs by creating options for food recovery. Additionally, it targets the behavioral level by offering an opportunity for students to practice mindful eating skills (e.g. taking a healthy snack hungrier than anticipated) and waste reduction (creating a sustainable method for disposal of uneaten foods.)

5.5 Future Considerations

The pilot test of *FTTF* yielded a plethora of information regarding its potential impact. The strategies used are designed to be guided by VL ideas for dissemination, to build leadership skills among VLs, create messages that are relatable for children, and encourage self-directed learning. Furthermore, experiential activities emphasized may lead to better outcomes among students.[126] With this perspective, engagement and participation may effect outcomes more than the specific activities completed. Similarly, cafeteria-based strategies should be tailored to the target school. In school where the foods served are of high quality and ample variety, it appears efficient to target the

cafeteria environment. Others may benefit by addressing food quality, variety, or acceptability. A detailed needs assessment is a suggested approach to identify strategies for a specific population.

Due to logistical constraints, some common SCT constructs were not adequately addressed. Parents and adult role models have powerful influence on children's dietary behaviors,[93,127] and future implementations should explore more extensive involvement. Observing the VL's enjoyment working with younger students was powerful, and more avenues for mentorship presents an opportunity for observational learning. Additional environmental constructs, like connecting with cafeteria composting and school gardening, would create positive options for disposal of food waste and increase engagement. Finally, connecting with the school's wellness committee would enable creation of policies that support sustained efforts, like mandating cafeteria greening initiatives (e.g. composting and food recovery) and targeting student intake (e.g. adding salad bars or limiting a la carte options.)

Fundamentally, balancing waste reduction efforts with nutritional goals is important. Frequent exposures to novel foods are important to increase acceptance,[128] and such opportunities will result in waste. Conversely, solely emphasizing reducing plate waste is antithetical to mindful eating and could encourage students to eat past comfortable fullness. However, the goals of waste reduction and encouraging healthy, mindful eating are not in competition if approached carefully. Students should be encouraged to think about food choices in advance, consider needs of their body and the planet, and become engaged with environmentally friendly ways to dispose of appropriate waste. Encouraging students to understand and appreciate how their needs are

related to the needs of their world is an empowering way to improve their health and the health of their surroundings. *FTTF* offers a framework for addressing these considerations, with potential to positively impact the development of children and reduce the environmental impact of school nutrition programs.

CHAPTER 6: IMPLEMENTATION OF A PILOT INTERVENTION TO IMPROVE PRODUCE INTAKE WHILE REDUCING PLATE WASTE DURING ELEMENTARY SCHOOL LUNCH

6.1 Introduction

School meals support healthful physical, emotional, and educational development for students by providing balanced meals and a supportive environment to learn healthful eating habits.[4–6] Unfortunately, rates of plate waste in the National School Lunch Program (NSLP) are estimated at 14-31% of foods served, with the highest rates for vegetables, dairy, and fruit.[3] High rates of plate waste in NSLP further represent a public health problem that is a combination of two potentially competing issues – encouraging students to improve their dietary intake by offering more healthy food could result in higher rates of waste, while encouraging students to reduce waste could unintentionally mean guiding them to eat past the point of comfortable fullness and undermine the development of healthy eating habits.

To some extent, previous findings support incorporating an emphasis on mindful eating into nutrition programs as a strategy to bridge these issues. Mindful eating encourages developing awareness of how eating affects one's self by understanding underlying cues to eat.[129] Such focus on non-judgmentally observing and understanding influences on eating behaviors may help individuals improve self-regulation skills, select healthier foods, and consume portion sizes that are appropriate for their personal nutritional needs.[99,101] The model of mindful eating can further be broadened to

encourage individuals to consider their physical needs and personal preferences along with resources used in food production and ways their eating behaviors impact the environment;[100] in this way, mindful eating emphasizes health and environmental sustainability.

Research on mindful eating interventions in school-aged populations is limited, though results are promising. Among 3rd-5th grade students, strategies including sensory activities, understanding hunger and fullness, and exposure to new foods appear useful to foster a sense of appreciation of the resources necessary to produce and prepare food[59] and improve preference for fruits and vegetables.[58] When tested in the general population, similar results have been seen, as well as increased propensity among general participants to choose smaller portions of energy dense foods.[100] Broader mindfulness strategies in school settings show additional benefits for children, including improved social behavior, emotional regulation, and academic performance.[102]

Although addressing the sustainability of school meals programs is important to reduce impact on the food system, it is critical that waste reduction efforts are compatible with child nutrition goals. Emphasizing both perspectives has the potential to encourage students to develop healthy eating habits and a sense of environmental stewardship. The purpose of this pilot study was to evaluate the feasibility and efficacy of a mindfulness-focused intervention (*Farm to Tray, Tray to Farm)* to encourage the development of mindful and sustainable eating behaviors among elementary school students participating in NSLP, with the goal of improving produce intake and reducing plate waste.

6.2 Methods

6.2.1 Study Setting & Design

Using a quasi-experimental controlled design, the current program, known as *Farm to Tray, Tray to Farm,* was implemented as a pilot trial during Spring 2019 at two public elementary schools within the same county school system in Maryland. Over 50% of the county's elementary school students qualify for free or reduced-price meals (FARMs) and the NSLP participation rate across the schools is approximately 60%.

After conducting a formative study in the same school system the year prior, two schools were recruited using convenience sampling. Although some characteristics of the school populations differ (specifically, the intervention school has a higher proportion of students who are FARM-eligible; 70.18% at the intervention school vs. 47.23% at the control school in school year 2018-2019[108]), the cafeterias at both schools have the same layout and design and the schools serve the same menu. Formative research indicated that targeting cafeteria environment changes may be an efficient method to influence student behaviors, so selecting schools on the basis of comparable layouts and available foods at baseline was prioritized.

6.2.2 Study Participants

After enrolling schools, teachers were contacted via email to invite their class to participate in data collection activities. The email was sent to all teachers in the schools; 8 teachers at the control school and 12 at the intervention school volunteered to participate and all of their classrooms were subsequently enrolled. Study announcements were sent home to the parents of children in these classes to explain the data collection activities in

which their child would be asked to voluntarily participate. An assent announcement was then delivered to these students on the data collection days to explain their role and that their participation was voluntary. Students in all grade levels (kindergarten – 5th) were eligible to participate in plate waste measurements and older students (3rd – 5th grade) were eligible to participate in a related psychosocial survey. In total, 430 students participated in some or all activities in the study.

6.2.3 Intervention

Farm to Tray, Tray to Farm is a school-based nutrition promotion program based in Social Cognitive Theory (SCT).[40] It aims to encourage students to development of mindful and sustainable eating behaviors during lunch through a combination of changes to the cafeteria environment and a knowledge- and skill-based curriculum disseminated by a small group of student leaders. A more extensive description of activities and lessons used in this study have been in earlier chapters. Briefly, the program consisted of a 16-week mindfulness- and sustainability-focused nutrition education delivered to a small group of peer leaders in the intervention school (n = 8), updated cafeteria environment (signage, menu board, and labeled items in the tray line) to promote produce consumption, and development of a cafeteria-based expanded sharing table that offered an opportunity to recover uneaten food. The 5th grade students were the primary recipients of lessons, the messages of which they then disseminated throughout the school through a series of self-directed activities that they planned and were moderated by the lead researcher, a registered dietitian. The intended audience for this project was the entire student body.

6.2.4 Data Collection

The study outcomes were the amount of plate waste produced at the individual level (n = 235 kindergarten – 5th grade students at baseline, 253 at follow-up, and 162 at both time points), changes in psychosocial factors, such as attitudes and beliefs related to mindful and sustainable eating behaviors (n = 210 3rd-5th grade students at baseline, 193 at follow-up, and 169 at both time points), and plate waste measured monthly at the school level (4 measurements per school). The breakdown of students who participated at each school and among different grade levels is shown in **Table 3**. The same classes were observed at both time points, but only students who ate a school lunch on the day plate waste was measured among their class or who were in attendance on the day the survey was administered to their class were eligible to participate in these activities. Because of variations in student purchasing and attendance, the samples varied somewhat at baseline and follow-up.

Student lunch observations were made over a 3-day period at each school to capture menu various within the school and separated by one week between schools to observe meals during the same weekdays. Participants were identified in meal observations by placing a laminated card with their unique ID number on their lunch tray. The same numbers were used at both time points and on all data collection forms to allow linking of these data sources.

The specific measures used to evaluate the pilot study are described below:

1) Digital photography was used to visually estimate the contents of student lunches at study baseline and conclusion. In this procedure, student trays were photographed using a standardized camera set-up immediately after the student exited the

tray line to capture pre-meal photographs. At the end of their lunch period researchers then collected trays from students to take post-meal photographs. Researchers performed minimal adjustments to trays prior to capturing the post-meal photograph to remove non-food items that could obstruct remaining food (e.g. napkins or wrappers.) Items that could not be visually estimated (e.g. milk and juice in opaque containers) were weighed separately, and recorded weights were used to calculate the proportion consumed of these items. Following data collection, pre- and post-meal photos were independently evaluated by two research assistants, who rated the proportion consumed of each component using a modified Comstock rating scale,[72,74] where the proportion eaten was estimated as none (0%), taste (10%), some (25%), half (50%), most (75%), or all (100%). Any visual ratings by the research assistants that differed by >1 point on the 6-point rating scale were reviewed and adjudicated by the lead researcher to reach a consensus. Approximately 89.4% of the initial ratings made by the two research assistants were in agreement. This measurement was used to estimate school meal intake and plate waste consumption by students.

To facilitate evaluation of student meal photographs, standard serving sizes for foods were obtained from production records and verified by weighing 2-3 samples of each food at baseline. Nutritional content of foods served and meal crediting information were provided by the county's registered dietitian; when values for certain foods were not available, they were collected from the manufacturer (for packaged items) or from the USDA's Standard Reference (for non-packaged items such as fresh fruits or vegetables.)[118] Food crediting values determine the number of servings of a food group each item counts for; for example, ½ half cup of cooked or raw vegetables or 1 cup of

leafy greens counts as one vegetable serving and 4 oz of juice and ½ cup of fruit/fruit juice or ¼ cup of dried fruit counts as one fruit serving. These data were compiled into a database and used to estimate the number of servings from various food groups, calorie content, and nutrient content of foods selected, consumed, and wasted by students. Evaluation of the pre-meal photographs yielded a list of foods selected by each student; multiplying the selected foods by corresponding nutrition data resulted in the nutrition content of food selected. From there, the foods selected were adjusted for the estimated proportion of each item that was eaten to determine the nutrition content of food consumed and food wasted by each student.

2) Survey: The participating classes from 3rd – 5th grades were asked to complete a survey to capture information about their dietary intake and changes in psychosocial factors related to mindful and sustainable eating at both baseline and follow-up periods, with items selected or adapted from previously tested instruments. The adapted survey used in this pilot is included as an appendix.

Four dietary intake questions were selected from a validated food frequency questionnaire[119] and asked about the number of times the student consumed fries/chips, vegetables, beans, and fruit during the previous day. Responses for these items ranged from 0 to 3 or more times. The original questionnaire had acceptable reliability (Cronbach's $\alpha < 0.6$) when tested in a sample of elementary school students.[119] Because of its conceptual difference, fries/chips was not used with the other three dietary questions in the later analysis, as these items aimed to estimate the number of eating occasions of produce during the previous day and was of primary interest in this study.

Other psychosocial key constructs measured in the survey were adapted from a more general eating behavior survey designed for use in young adolescents that intended to measure changes in SCT-related constructs.[48] The selected items were reworded to more specifically ask about mindfulness- and sustainability-related behaviors, and the instrument was abbreviated to probe about five specific SCT constructs: self-efficacy to base lunch choices on body cues, intentions to select and eat healthy cafeteria foods, behavioral strategies used to practice mindful and sustainable skills at lunch, expectations of health benefits resulting from mindful and sustainable behaviors, and perceived importance of experiencing health benefits. Items were rated on Likert-type scales, with six possible responses for self-efficacy and expectations items (ranging from "disagree a lot" to "agree a lot"), five possible responses for behavioral strategies items (ranging from "never" to "always"), and four possible responses for importance (ranging from "not at all important" to "very important") and intentions (ranging from "not at all true of me" to "very true of me.") Because formative feedback emphasized the need for data collection to be quick and unobtrusive during the instructional school day, one goal of adapting the survey (in addition to emphasizing mindful and sustainable behaviors) was creating a shorter instrument; for this reason, and because a mediation analysis evaluating behavior change theories in the context of school-based nutrition interventions showed the least evidence for social norms in predicting behavior,[51] items targeting social support and situation constructs were removed. Reliability of remaining constructs in the original scale ranged from $\alpha = 0.65$ (perceived importance) – 0.75 (behavioral strategies).[48] The original instrument was also analyzed with confirmatory factor analysis; the included

constructs showed acceptable to good fit for the SCT model, thereby demonstrating factorial validity when measuring adolescent eating behaviors.[48]

Prior to administration, the instrument was reviewed with subject-matter experts to ensure content validity and pilot tested with a group of 50 3rd-5th grade students to ensure the questions were understandable and of an appropriate reading level. Reliability of the adapted survey instrument was evaluated in two ways: internal consistency (using Cronbach's alpha) and the intraclass correlation coefficient of each subscale were evaluated using the entire baseline sample. In additional, stability was evaluated by generating Spearman's rho coefficient of test-retest reliability for the control sample only at baseline and follow-up. Reliability analyses (**Table 12**) showed relatively stable results and acceptable reliability for the expectations and intentions subscales. Results were less acceptable results for other variables but, because of their relative stability and because composite variables by definition are more reliable than single-item measures, they were maintained in the analysis of this pilot study. Two items were removed from the self-efficacy subscale and one was removed from the behavioral strategies subscale, which improved ICC and α for both.

***Table 12**: Reliability analysis of behavioral survey*

Subscale	Internal consistency – Cronbach's alpha	Intraclass Correlation Coefficient (95% CI)	Test-retest – Spearman's rho (p-value)
Produce intake (previous day)	0.515	0.409 (0.171, 0.574)	0.345 (0.005)
Self-efficacy	0.502	0.470 (0.338, 0.581)	0.488 (< 0.001)
Intentions	0.440	0.393 (0.221, 0.530)	0.410 (0.001)
Behavioral strategies	0.530	0.517 (0.400, 0.616)	0.542 (< 0.001)
Expectations	0.643	0.646 (0.553, 0.722)	0.554 (< 0.001)
Importance	0.600	0.587 (0.477, 0.677)	0.465 (< 0.001)

All students in the participating classes were eligible to complete the survey, including students who did not eat a school-provided lunch.

3) Plate waste at school level: Plate waste was measured at the school-level by conducting a series of food waste audits using a methodology suggested by the USDA and EPA.[120] Four monthly audits were conducted each school, on days when the schools served the same menu. Because of space and time constraints, lunch trays were collected from approximately one third of each grade at the end of their lunch period during all but the first measurement. The items remaining on student trays were then separated by data collectors into buckets labeled for meat/meat alternate, grains, dairy, fruit, vegetables, and snacks/a la carte items. Inedible items (e.g. cores, peels, napkins) were discarded into the trash. After the items collected from an individual grade were sorted, buckets were weighed and the number of trays were counted to determine average per-student estimates.

6.2.5 Analysis

Digital photography of student meals yielded estimates of foods selected and the corresponding proportion consumed or discarded of each. These were further adjusted for items donated to or taken from the share table. Incorporating nutrient information resulted in estimated nutritional content of foods selected, consumed, and discarded. Examination for normality, outliers, and data points with high influence or leverage identified 3 outliers, which were removed. Records for students whose pre-meal photos were missing due to camera errors (n = 38; 7.2% of observations) were removed from the data set. When post-meal photos were missing (n = 44; 8.3% of observations) either

because of a student disposing of their tray before it could be collected or because of camera errors), proportions of items that students consumed were imputed using the mean proportion consumed within their respective school. Changes in student intake and plate waste from baseline to follow-up at each school were compared using independent samples t-tests to evaluate between group differences and with paired samples t-tests to evaluate changes at each site from baseline to follow up. When indicated by unequal variances among the two samples, non-parametric alternatives were used.

Survey items were compiled into composite variables prior to analysis to create variables that estimate unobserved constructs on the basis of multiple questions. Dietary questions about vegetable, bean, and fruit intake during the previous day (food frequency questions included in the instrument) were summed to estimate the number of eating occasions of produce during the previous day; the range of possible responses was 0 – 9 eating occasions. Remaining items for each subscale were averaged to create a composite measure for each SCT construct measured in this study; possible scores were 1 – 6 for self-efficacy and expectations, 1 – 5 for behavioral strategies, and 1 – 4 for intentions and importance. Categorical results from the survey were analyzed with the Mann Whitney U test to evaluate between-subject effects at each time point and the Wilcoxon Rank-Sum test to evaluate within-subject changes over time.

Follow-up psychosocial results were then used in univariate linear regression models to identify important predictors of selection, consumption, and waste behaviors for vegetables and fruit at follow-up. The outcomes observed through meal observations were each treated as dependent variables with school, grade, the previous day's produce intake, and composite psychosocial variables as predictors. In addition, when creating

models to predict fruit or vegetable waste, the number of servings of fruit or vegetables selected (respectively) was included as a control. When creating models to predict fruit or vegetable consumption, both the number of fruit or vegetables selected and caloric consumption were included as control variables. The models were run initially with all possible predictor variables and backwards selection methods were employed to retain only those predictors that contributed significantly to the model.

School-wide plate waste was analyzed using a univariate linear regression model to predict the effect of treatment (intervention versus control school), time, grade level, and the interaction of time and treatment on the amount of plate waste produced.

Analyses were done in SPSS version 24. All procedures used in the pilot implementation of *Farm to Tray, Tray to Farm* were approved by the University of Maryland, College Park Institutional Review Board.

6.3 Results

6.3.1 Produce and Energy Content of Student Intake and Plate Waste

The nutritional content of student lunches was evaluated through visual estimation of digitally captured photographs of student-selected lunch trays before and after eating. This evaluation and subsequent analysis yielded the nutritional composition of foods selected, consumed, and wasted. Using the sample of students who participated in both baseline and follow-up meal observations (n = 162), **Table 13** shows estimates of servings of produce and caloric content of foods selected, consumed, and wasted, highlighting several baseline differences between the two study sites and changes within each school over time.

Table 13: *Average produce and energy selected, consumed, and wasted per student (n = 162)*

Category		Intervention School (n = 122)			Control School (n = 40)			P-value*
		Baseline	Follow-up	Change	Baseline	Follow-up	Change	
Vegetable (servings)	Selected	1.09 (.43)	1.10 (.33)	0.02 (.51)	1.25 (.64)	0.66 (.47)	-0.59 (.76)[1]	< 0.001[2]
	Consumed	0.45 (.48)	0.50 (.49)	0.05 (.57)	0.45 (.51)	0.30 (.37)	-0.14 (.62)	0.067
	Wasted	0.64 (.46)	0.57 (.53)	-0.03 (.62)	0.80 (.63)	0.36 (.46)	-0.45 (.62)[1]	< 0.001
Fruit (servings)	Selected	1.16 (45)	1.33 (.69)	0.16 (.76)[1]	0.88 (.82)	1.03 (.70)	0.15 (.89)	NS
	Consumed	0.74 (.55)	0.97 (.68)	0.23 (.71)[1]	0.59 (.61)	0.65 (.63)	0.06 (.79)	NS
	Wasted	0.42 (.46)	0.36 (.42)	-0.06 (.59)	0.29 (.42)	0.38 (.46)	0.09 (.59)	NS
Energy (kcal)	Selected	627.67 (159.92)	671.70 (145.96)	43.94 (210.97)[1]	570.80 (164.41)	642.08 (112.26)	71.28 (156.99)[1]	NS[2]
	Consumed	439.67 (148.30)	466.81 (171.01)	27.14 (187.32)	357.77 (159.96)	416.62 (178.21)	58.86 (183.71)[1]	NS
	Wasted	188.09 (144.11)	204.89 (153.18)	16.80 (184.81)	213.03 (152.65)	225.45 (163.57)	12.42 (155.75)	NS

*Comparison of between school differences; tested statistical significance of change values using independent samples t-test
[1]Paired samples t-test shows statistically significant ($p < 0.05$) within school difference from baseline to follow-up
[2]Significant result from Levene's test indicated unequal variances of two subsamples; non-parametric alternative used

When selection patterns were examined, several significant relationships emerged. An overall difference in produce selection at follow-up was seen when the two schools were compared. Although baseline vegetable selection did not differ between the schools, the number of servings selected by intervention school students did not substantially change, while control school students decreased significantly (+0.021 at the intervention school vs. -0.588 at the control school; $p < 0.001$ for between group difference and $p < 0.001$ for within group difference at the control school.) Intervention school students selected significantly more fruit at both baseline (1.2 vs 0.9 servings, $p = 0.039$) and follow-up (1.3 vs 1.0 servings, $p = 0.020$) when compared to the control school, and also demonstrated a significant increase from baseline to follow-up ($p = 0.019$) whereas the control school did not change significantly over time. Both schools selected meals with higher energy content at follow-up than at baseline. Intervention

school students trended toward higher energy selection than control school students at baseline (627.8 vs 570.8 kcal, $p = 0.054$), but the schools did not differ at follow-up. The same trends were seen when all available meal observations were analyzed and when early (k – 2nd grade) and late (3rd – 5th) elementary school students were analyzed separately.

Consumption estimates for vegetables, fruit, and energy showed additional patterns. Students at the intervention school consumed more vegetables than students at the control school at follow-up (0.5 vs. 0.3 servings, $p = 0.008$), but did not differ at baseline. Although it was previously noted that selection of vegetables decreased at the control school, consumption did not change from baseline to follow-up, except among young elementary students (from 0.75 to 0.18 servings.) Fruit consumption increased at the intervention school from baseline to follow-up (from 1.2 to 1.3 servings, $p = 0.019$) and was higher than at the control school at follow-up ($p = 0.009$). Energy consumption was initially higher at the intervention school (439.7 vs. 357.8 kcal, $p = 0.003$) and was not observed to change at the intervention school from baseline to follow-up. Similar fruit and energy consumption trends were seen among all subgroup analyses.

Observed differences in the produce and energy content of waste were subtler than trends seen in selection and consumption. Notably, vegetable waste appears to have decreased at the control school (from 0.8 to 0.4 servings, $p < 0.001$), a trend that is likely due, at least in part, to their lower selection of vegetables at follow-up. When waste is considered proportionate to the amount students selected, control and intervention school students both discarded approximately 54.6% of the vegetable they were served. While the proportion of vegetables wasted seems to have improved for both schools (at baseline,

intervention students discarded 58.7% and control students discarded 64.0%), data suggest that students at the intervention school achieved this reduction by increasing their consumption of vegetables, rather than by selecting less. Fruit waste did not differ significantly during the course of the intervention or when schools were compared, ranging from 0.3 to 0.4 servings. Energy waste was also similar when schools and time points were compared, with students discarding approximately 188.1 – 225.5 kcals. Other subgroup analyses on produce or energy waste did not show significant differences.

6.3.2 Detailed Nutrient Content of Lunch Consumption and Plate Waste

More detailed analyses of nutritional and waste composition data were conducted to determine differences in nutrient consumption and waste patterns (**Table 14**.) While several baseline differences existed, examination of changes in nutrient intake and waste over the course of the intervention showed a pattern indicating shifting student patterns, particularly with regard to consumption at lunch. From baseline to follow-up, results indicated that intervention students had a smaller increase in fat consumption (+0.62 g vs. +3.85 g, $p = 0.033$) than students at the control school. While students at the control school had increased intake of some nutrients from baseline to follow-up, students at the intervention school did not substantially change their consumption of protein (-0.37 g vs. 4.75 g, $p = 0.007$) or iron (-0.08 mg vs. +1.23 mg, $p < 0.001$). Additionally, intervention students showed a decrease in saturated fat (-0.77 g vs. +1.40 g, $p = 0.01$) and calcium (-105.12 vs. + 113.04 mg, $p < 0.001$) consumption during the intervention when compared to control students. Recognizing that intervention school students did not have an observed difference in the caloric consumption of their lunches from baseline to follow-up and consumed roughly the same amount as control school students, these differences

may indicate that intervention students consumed less meat and dairy than control school students while replacing with calories from other food groups (such as fruits, vegetables, or grains). Counterintuitively, intervention students were observed to maintain their sugar consumption while control school students decreased from baseline to follow-up (+0.12 g vs. – 5.08 g, $p = 0.039$). Few changes in waste patterns were observed, except that fiber waste remained approximately the same at the intervention school (+ 0.06 g) and increased by 1.31 g at the control school ($p = 0.024$).

***Table 14**: Detailed nutrient analysis of lunch consumption and plate waste (n = 162)*

Category		Intervention School (n = 102)			Control School (n = 67)			P-value*
		Baseline	Follow-up	Change	Baseline	Follow-up	Change	
Fat (grams)	Consumption	13.99 (6.67)	14.35 (6.79)	0.62 (8.25)	9.19 (5.04)	14.13 (7.04)	3.85 (8.17)[1]	0.033
	Waste	5.25 (5.44)	5.80 (5.67)	0.04 (7.05)	5.76 (5.49)	6.13 (5.87)	0.17 (6.54)	NS
Saturated fat (grams)	Consumption	4.06 (2.79)	3.38 (2.27)	-0.77 (3.47)[1]	2.86 (1.95)	4.01 (2.70)	1.40 (3.30)[1]	0.001
	Waste	1.38 (1.81)	1.26 (1.56)	-0.26 (2.22)	1.60 (1.62)	1.31 (1.43)	-0.32 (1.87)	NS
Cholesterol (mg)	Consumption	32.61 (19.26)	29.26 (17.59)	-2.012 (25.26)	23.41 (24.39)	26.77 (19.97)	5.23 (33.71)	NS
	Waste	10.51 (10.12)	11.59 (14.83)	-0.54 (13.28)	11.79 (15.26)	10.80 (13.75)	0.89 (21.95)	NS
Sodium (mg)	Consumption	561.05 (194.19)	621.08 (267.97)	88.59 (285.59)[1]	454.06 (287.77)	578.66 (241.53)	73.50 (319.21)	NS
	Waste	240.15 (188.47)	291.54 (231.48)	40.51 (268.53)	248.40 (254.94)	281.61 (250.59)	60.36 (266.99)	NS
Carbohydrates (g)	Consumption	58.75 (21.39)	63.57 (23.83)	6.37 (26.59)[1]	51.53 (24.47)	63.12 (26.38)	2.04 (24.92)	NS
	Waste	28.62 (19.33)	32.42 (20.83)	3.37 (26.19)	29.20 (20.19)	31.99 (24.69)	2.69 (21.23)	NS
Fiber (g)	Consumption	4.83 (2.54)	5.13 (2.89)	0.45 (3.48)	3.35 (1.94)	5.42 (2.72)	1.49 (3.05)[1]	0.092
	Waste	3.02 (1.98)	2.98 (2.38)	0.06 (3.13)	2.56 (2.02)	3.66 (2.83)	1.31 (2.27)[1]	0.024
Sugar (g)	Consumption	25.11 (12.14)	24.65 (11.61)	0.12 (13.40)	26.26 (15.22)	25.34 (13.22)	-5.08 (14.58)[1]	0.039
	Waste	12.26 (10.58)	11.76 (9.84)	-0.77 (13.61)	10.77 (10.16)	11.12 (11.74)	-0.46 (11.90)	NS
Protein (g)	Consumption	20.73 (8.20)	19.65 (8.60)	-0.37 (9.91)	15.59 (8.13)	21.69 (9.32)	4.75 (11.45)[1]	0.007
	Waste	9.03 (7.27)	10.07 (7.91)	0.74 (9.59)	9.98 (7.31)	9.85 (8.72)	1.29 (9.04)	NS
Calcium (mg)	Consumption	368.47 (211.43)	262.09 (196.46)	-105.12 (263.22)[1]	252.62 (155.83)	380.96 (251.97)	113.04 (235.28)[1]	<0.001
	Waste	167.86 (162.83)	146.13 (142.82)	-26.71 (197.49)	141.18 (152.57)	128.29 (132.21)	-26.94 (179.45)	NS
Iron (mg)	Consumption	2.74 (1.49)	2.59 (1.49)	-0.08 (1.98)	1.37 (0.73)	2.84 (1.49)	1.23 (1.48)[1]	<0.001
	Waste	1.18 (1.00)	1.46 (1.66)	0.33 (2.09)	1.10 (1.54)	1.37 (1.23)	0.53 (1.58)[1]	NS
Vitamin A (IU)	Consumption	603.88 (436.65)	475.83 (702.24)	-96.94 (911.38)	562.12 (1056.40)	538.39 (389.39)	-52.82 (1485.61)	NS
	Waste	497.34 (359.56)	260.11 (383.75)	-259.10 (460.21)[1]	415.62 (508.80)	305.29 (724.41)	-75.46 (1122.11)	NS
Vitamin C (mg)	Consumption	35.50 (38.13)	46.33 (41.55)	15.33 (54.05)[1]	19.70 (27.19)	18.61 (22.73)	-3.52 (30.66)	0.007
	Waste	21.05 (20.79)	17.19 (23.71)	-4.59 (28.38)	13.07 (16.87)	8.49 (12.37)	-6.76 (19.22)[1]	NS

*Comparison of between school differences; tested statistical significance of change values using independent samples t-test
[1]Paired samples t-test test shows statistically significant ($p < 0.05$) within school difference from baseline to follow-up

6.3.3 Mindful and Sustainable Eating Questionnaire Results

The distribution of responses to selected psychosocial items are presented in **Table 15**. While no significant differences among changes of psychosocial variables between the two schools were observed during the intervention, students at the intervention school trended toward reporting higher self-efficacy at follow-up than at baseline (increasing ratings from 4.04 to 4.41, p = 0.004).

***Table 15**: Comparison of psychosocial responses among 3rd-5th grade students (n = 169)*

Category	Intervention School (n = 102)			Control School (n = 67)			P-value*
	Baseline	Follow-up	Change	Baseline	Follow-up	Change	
Produce Intake (times eaten on previous day)	2.27 (1.68)	2.37 (1.69)	0.01 (1.68)	2.79 (2.09)	2.64 (1.71)	-0.14	NS
Self-efficacy to base lunch choices on body cues	4.07 (1.12)	4.41 (1.00)	0.33 (1.11)[1]	4.23 (1.05)	4.31 (1.07)	0.08 (1.09)	0.129
Intentions to select and eat healthy cafeteria foods	3.01 (0.67)	2.84 (0.76)	-0.20 (0.77)[2]	2.80 (0.63)	2.92 (0.65)	0.05 (0.79)	0.369
Behavioral strategies to practice mindful skills	3.01 (0.97)	2.98 (0.82)	-0.03 (0.96)	3.11 (0.65)	2.97 (0.93)	-0.17 (0.79)	0.226
Expected health benefits resulting from mindful behaviors	3.88 (1.24)	4.08 (1.02)	0.17 (1.14)	3.86 (0.99)	3.70 (1.16)	-0.15 (1.19)	0.188
Importance of experiencing health benefits	2.96 (0.63)	3.01 (0.66)	0.03 (0.67)	2.96 (0.66)	2.85 (0.66)	-0.09 (0.69)	0.479

*Comparison of between school differences; tested statistical significance of change values using Mann-Whitney U test

[1]Wilcoxon Signed Rank test shows statistically significant ($p < 0.05$) within school difference from baseline to follow-up

[2]Wilcoxon Signed Rank test result for within school difference approached statistical significance ($p = 0.053$)

6.3.4 Predictors of Plate Waste and Produce Intake

The regression analysis presented in **Table 16** shows variables that were significant predictors of intake and plate waste patterns. As expected, the number of servings selected predicted fruit and vegetable consumption and waste patterns, where students are predicted to consume an additional 0.403 servings of vegetables and 0.710 servings of fruit for every increased serving of vegetable or fruit, respectively. Vegetable and fruit waste increased by proportional amounts as well, as the models show waste increasing by 0.558 servings of vegetables and 0.294 servings for fruit for each additional serving selected. Unsurprisingly, energy intake also had a positive relationship with fruit and vegetable consumption, where each additional kcal consumed predicted slightly higher produce consumption. Group membership predicted only fruit and vegetable consumption, where being a student at the intervention school predicted selection of 0.442 more vegetable servings and 0.318 more fruit servings.

***Table 16**: Predictors of produce selection, consumption, and waste behaviors by linear regression (n = 87)*

Model	Variable	Coefficient (se)	P-value
Vegetable servings selected $R^2 = 0.246$	Intercept	1.897 (0.188)	<0.001
	School	-0.442 (0.090)	<0.001
	Beliefs	-0.142 (0.046)	0.008
Vegetable servings consumed $R^2 = 0.451$	Intercept	-0.848 (0.274)	0.003
	Grade	0.134 (0.045)	0.004
	Vegetables servings selected	0.403 (0.082)	<0.001
	Calories consumed	0.001 (0.000)	<0.001
	Intentions	0.159 (0.053)	0.004
	Importance	-0.151 (0.070)	0.034
Vegetable servings wasted $R^2 = 0.439$	Intercept	.450 (0.283)	0.115
	Grade	-0.177 (0.048)	<0.001
	Vegetable servings selected	0.558 (0.089)	<0.001
	Intentions	-0.168 (0.058)	0.005
	Importance	0.202 (0.089)	<0.001
Fruit servings selected $R^2 = 0.\ 117$	Intercept	0.672 (0.444)	0.133
	School	-0.318 (0.174)	0.071
	Grade	0.265 (0.092)	0.005
Fruit servings consumed $R^2 = 0.673$	Intercept	-0.172 (0.145)	0.237
	Fruit servings selected	0.710 (0.052)	<0.001
	Calories consumed	0.000 (0.000)	0.067
Fruit servings wasted $R^2 = 0.252$	Intercept	-0.053 (0.079)	0.505
	Fruit servings selected	0.294 (0.052)	<0.001

6.3.5 School-Wide Plate Waste Results

A summary of school-wide plate waste measurements is shown in **Table 17.** Among the categories measured, dairy foods comprised the largest amount of plate waste by weight, followed by fruit and grains, respectively. These results indicate that students at the intervention school may have trended toward producing less meat, dairy, grain, and fruit waste over the course of the intervention. Vegetable waste trends appear less consistent. Students at the control school may have slightly increased waste resulting

from meat, grain, and dairy, slightly reduced vegetable waste, and maintained a similar level of fruit waste.

***Table 17**: Per-student estimate of plate waste by food group in grams; measured at school-wide level*

		Baseline	Intermediate time points		Follow-up
	Site	Observation 1	Observation 2	Observation 3	Observation 4
Number observed	Intervention	505	219	160	194
	Control	148	137	138	117
Meat waste	Intervention	23.66	20.16	14.18	14.47
	Control	7.80	11.13	18.47	13.66
Grain waste	Intervention	31.52	24.29	26.82	26.09
	Control	21.43	25.71	29.09	30.94
Dairy waste	Intervention	80.92	67.52	46.07	51.67
	Control	65.60	80.61	67.48	87.98
Fruit waste	Intervention	48.36	39.44	29.89	49.46
	Control	52.28	50.48	25.18	50.48
Vegetable waste	Intervention	40.50	21.38	29.03	25.68
	Control	27.32	22.31	19.88	21.58
Snack/a la carte waste	Intervention	19.17	4.31	1.06	4.12
	Control	6.52	4.54	1.66	1.45

6.4 Discussion

The present study aimed to test the feasibility and efficacy of a nutrition promotion program that focused on emphasizing mindful and sustainable eating in improving produce intake and reducing plate waste during elementary school lunch. Overall, implementation of the pilot program was feasible, and results indicate that it may be a useful model for developing more mindful and sustainable eating behaviors.

Although baseline differences in consumption on plate waste patterns were evident at baseline, students at the intervention school experienced positive changes with regard to their selection and consumption of fruit and vegetables that were not seen in the control group. While equivalent consumption at baseline would have enabled more straightforward interpretation of study findings, this result provides some evidence that

the program encouraged healthier intake among participants. Additionally, analyses of nutritional intake showed changes in intake among students at the intervention school (including reduced saturate fat and increased vitamin C) without significant changes in caloric intake that may support the idea that these students are selecting more fruits and vegetables in place of higher fat items, like snack foods.

Counterintuitively, vegetable waste was higher at the intervention school than at the control school (although not significantly different from baseline.) This was not anticipated but does not necessary indicate a negative outcome as selection of vegetables was also higher at the intervention school. Frequent exposures to novel healthy foods is often discussed as an important precursor to acceptance among children;[90] in this way, the higher selection of vegetables by students at the intervention school may indicate increased exposure to these foods, and it is possible that this change is a precursor to increased acceptance. Regression analyses showed that the number of servings selected was an important predictor for both consumption and waste of produce; considering this along with measured increases in selection further supports the conclusion that participants trended toward positive behavioral changes as a result of the study.

Fruit waste, which was higher at the intervention school at baseline, was not significantly different at follow-up from the control school. Lower rates of waste for fruits than vegetables indicate that students are more accepting of fruit**,** an early sign that the program may have a beneficial effect on reducing plate waste among students. Because vegetables are a less acceptable food by this population, it may be that the intervention would need to be longer or more intensive to demonstrate reduced waste and increased acceptance of that food group. Finally, students at the intervention school

produced plate waste with significantly less vitamin A at follow-up than they did at baseline; because levels of vitamin A are high in many fruits and vegetables, this further supports a trend toward less fruit and vegetable waste at lunch.

Participants also experienced positive changes in some psychosocial variables captured in the survey. When compared to dietary outcomes, it appears that students who reported improvements in their intentions regarding mindful and sustainable eating also experienced positive changes in their dietary intake at lunch. Importance ratings exhibited an opposite relationship, perhaps indicating that the items that comprised this construct were not adequately capturing true perceptions. Increased behavioral strategies ratings was associated with decreased vegetable selection; while this is not necessarily a desired outcome, it may indicate that these students were more mindfully considering their available produce options and selecting fruit (typically better liked by elementary school students) instead. These results highlight a need to address student food preferences for vegetables and can be achieved by a variety of technique, including: incorporating more frequent taste tests of these foods, using Smarter Lunchroom strategies like creative naming, and continuing to offer frequent exposures to these foods.[14,123]

Overall, regression and correlation results show some expected relationships between psychosocial characteristics and dietary outcomes, supporting the use of SCT as the theoretical foundation for this program and the idea that emphasizing mindfulness and sustainability are useful strategies for influencing the foods that students select and consume. Within the context of SCT, psychosocial factors can be considered antecedents to human behavior and may therefore indicate the potential to further improve measurable outcomes (including intake and amounts of plate waste) over a longer period

of time. Because reliability analysis of the survey had less than ideal results, additional testing is necessary to refine and improve the instrument's ability to measure changes in attitudes and beliefs of this population. Cognitive testing with elementary school students would be useful to demonstrate validity of the items in measuring the intended constructs and repeated testing in a larger, more diverse sample would help establish better evidence of reliability. Still, while the survey should be interpreted with caution, borderline acceptable reliability results achieved from a variety of methods indicate that survey results are informative when evaluating this pilot intervention.

Comparison to previous research lends credibility to the findings, overall. Students in this study wasted more vegetables than fruit, and overall waste levels were higher among younger students; both trends have previously been demonstrated.[6,33,34] While rates of plate waste from meal observations appears higher than those found in national estimates,[3] they are similar to those found in earlier studies where students were estimated to waste up 40% of foods served.[32–34] This difference may be the result of characteristics of the particular school system studied, as national estimates would not reflect an individual community's traits so strongly. Furthermore, patterns observed in this study, where waste was highest among dairy, vegetables, and fruit, generally agree with previous findings.[3] Previous mindful eating research in this age range showed that students increased their preference for fruits and vegetables; considering this along with higher selection observed presently shows consistency among results of mindfulness interventions.

Because of the nature of pilot testing a new program, it was not realistic to utilize a large and varied sample of schools or to provide a longer duration program, and results

should be interpreted cautiously. It is unfortunate that baseline differences were observed among students at the two schools and, while the effect of this should not be ignored, these differences should be considered in the context of a small, pilot implementation. Despite these limitations, results suggest a benefit regarding attitudes and beliefs about mindful and sustainable eating, nutritional intake at lunch, and overall plate waste patterns. Testing in a larger sample is worthwhile.

6.5 Conclusion

Overall, the *Farm to Tray, Tray to Farm* program had positive results the schools where it was tested. Student attitudes and beliefs improved, as did their selection and consumption of produce at lunch. Further testing is necessary to document clearer evidence about the program's ability to reduce plate waste, but findings suggest trends in a positive direction. Long term, the effects of this program have the potential to improve the health and development of children, reduce the environmental burden posed by plate waste in NSLP, and reduce the costs for schools associated with serving and disposing of foods that go uneaten in the cafeteria.

CHAPTER 7: DISCUSSION

7.1 Summary of Pilot Implementation Findings

Dietary intake of school children rarely meets guidelines, a problem exacerbated by high rates of plate waste that undermines USDA child nutrition goals. Simply addressing either perspective of high waste in the context of suboptimal intake (i.e. only targeting plate waste or only targeting nutrition), could cause an imbalance and creative solutions are needed to target this problem more wholly. Research on causes of plate waste in schools[6,15,24,38] mirrors many of the causes of consumer-level waste observed in the general population, namely lack of knowledge about appropriate intake or portions, perceptions of poor food quality, and psychosocial factors like taste preferences and attitudes.[19] Emphasizing mindful eating skills and sustainability are strategies that can target preferences and attitudes to improve intake and reduce plate waste among school children and, in light of some overlapping causes of waste among students and the general population, effective strategies could be applicable to all people, regardless of age.

The current project emphasized fostering mindful and sustainable eating behaviors among school children as a method to increase consumption of fruits and vegetables and decrease plate waste at lunch. Eating behaviors can be considered both mindful and sustainable when the individual considers their physical needs, remains aware of emotional, personal, and external cues that influence choices, and observes the environmental/social implications of their choices when selecting and consuming food. While these are advanced skills, children can learn to participate in mindful and

sustainable behaviors by exploring sensory aspects of food, learning to understand their body's hunger and fullness cues, and understanding and appreciating the resources involved in food production and preparation.

Elementary schools were specifically targeted for this study, as previous research has shown elementary school students create more plate waste than older students. Further, because NSLP serves 30 million students per day[3] with key goals to improve nutritional status and food security, targeting students who receive school meals is an efficient way to reach a large audience with ongoing need for nutrition intervention. This research was intended to design and implement a pilot intervention to encourage elementary school students to develop mindful and sustainable eating behaviors. By doing this, the study aimed to increase produce intake while reducing plate waste generated by students at lunch.

The formative study revealed that students have relatively little knowledge about nutrition, mindful eating, and the food system but are interested in learning more about these topics. They expressed motivation in reducing food waste if doing so could help members of their community who are food insecure. The formative activities identified several psychosocial constructs that appear to influence children's eating behaviors at lunch, including factors at the personal, behavioral, and environmental levels. Such factors support a behavioral model to understand the development of mindful and sustainable eating behaviors that is built from SCT.

Among the identified factors were cafeteria characteristics that appeared promising to target in the program. Children in focus groups reported not knowing what options were available for lunch each day, despite existing menu boards in the cafeteria,

menus being sent home, and announcements of the daily options each morning. Lack of awareness of available choices lead to students perceiving that they had limited autonomy in meal selection; consideration of this along with their report that being forced to eat certain foods or at a certain time made it more difficult to eat according to their hunger cues indicates that incorporating additional methods to inform students of daily options could be helpful. Further observations that menus in the cafeteria were not consistently updated highlighted an important opportunity to improve information available to students in ways that would draw their attention and focus. Through this, emphasizing available produce choices appeared to be a strategy to call attention to the autonomy that students already possessed in their meal selection, encourage mindful selection, and place more focus on fruits and vegetables as a central aspect of the school lunch meal.

Formative results also showed how student beliefs and dietary behaviors were influenced by forces outside of themselves. They repeatedly discussed how they base their food choices on their perceptions of their peers' attitudes and that the amount they consume is guided by their parent's influence or some external standard, like package sizes. Mindfulness skills would enable students to shift the basis for their decision-making around food, encouraging them to make choices based on their own needs and preferences. However, the effect of peer attitudes should not be ignored; as a result of the formative study, this was identified as a powerful influence and utilizing student leaders to disseminate health and sustainability messages showed potential to capitalize on this influence in a positive way.

Finally, formative results highlighted how moral concerns were a primary motivator for students of this age group when considering food waste reduction. Review

of psychological theories of cognitive development shows that elementary school-aged children are typically developing traits related to empathy at this age – they generally develop feelings of morality from a concrete and unchangeable perspective, have a strong concern for the welfare of others and need for equality, and gradually develop more abstract and context-dependent ethical ideas as they transition out of elementary school.[130] This understanding of child development supports formative findings, where students had clear and definitive judgements about when it was "good" or "bad" to waste food and were primarily interested in reducing food waste to prevent harm to others or promote equality. They were specifically focused on how wasting food is wrong when people in their community experience hunger, discussing this frequently in all focus groups, and also repeatedly discussed how wasting food could harm the Earth by creating litter. While their knowledge was limited in these processes and their perspectives were somewhat simplistic, it was evident that these moral considerations are important to elementary school children and stem from their strong sense of right and wrong. These concepts were identified as critically important to the behavioral model; emphasizing the connection between their personal actions with possible food insecurity and environmental sustainability outcomes was a powerful way to increase motivation and interest in behavior change. Providing opportunities to practice skills that would allow them to "do the right thing" when selecting or disposing of food would further improve their self-efficacy and empower them to become more mindful and sustainable eaters. Previous research shows that creating supports to reinforce and incentivize positive behavior is an effective means of encouraging behavior change and a recommended practice in education systems;[131] this concept supports the incorporation of strategies to

practice and model healthy behaviors as part of *FTTF*, and agrees with the overall formative findings.

Collectively, these formative results showed an important opportunity to design a program to target mindful and sustainable eating behaviors. Students were interested in learning about topics related to nutrition and the food system and, given their low familiarity with these topics, there was ample room to encourage increased knowledge. Moreover, they identified important motivating and influential factors. Empowering students to recognize their autonomy to choose what they like and ability to understand their body's messages, encouraging them to consume more produce through the use of positive peer influence, and appealing to their strong sense of right and wrong were strategies that became the basis of the *FTTF* program.

Designing the program to target the behavioral model was challenging but largely successful. While there was no existing education curriculum that specifically targeted mindful and sustainable behaviors of children, a recently published mindful eating program (Foodie U)[60] provided an efficient way to incorporate tested, well-designed mindfulness education. As mindfulness is a topic rooted in psychology, being able to draw from a program developed by experts in the discipline enabled the nutrition-focused intervention to more effectively teach mindfulness concepts than if they had been self-developed. Similarly, many programs exist to teach students about the food system. Although intended for an older audience, FoodSpan[56] was developed by highly accomplished and experienced researchers with expertise centered specifically on the food system. Drawing concepts from this program provided a model to prioritize topics for inclusion and incorporate effective and engaging activities. Compiling and adapting

existing resources was an efficient way to create a curriculum with potential to encourage behavior change.

Changes to the cafeteria environment and dissemination by student leaders were strategies that created a cohesive and far reaching program. These directly targeted concepts identified in the formative study and increased engagement and project visibility throughout the school. Children were excited to respond to questions posed on the feedback board, receive prizes for participating in the mindful eating contest, and learn from the Veggie Leaders. Labeling items in the tray line and adding the fruit and vegetable menu board appeared to be helpful in encouraging students to consider their lunch options. Collectively, these techniques were informed by SL concepts,[14] adding another mechanism for the program to incorporate tested and well-received strategies.

Most challenges were encountered when developing alternative avenues for waste disposal in the cafeteria. One school included in the formative study had a cafeteria-based composting program, and initially, the research team intended to expand this to the intervention school as part of the study. Unfortunately, because of the school system's rural location, there was not a commercial composter available to serve that area. Alternative approaches, like composting on the school grounds, were not feasible for this pilot intervention for several reasons. Single stream composting, where all foods (including meat and dairy), are composted together, requires expensive equipment and expertise beyond the scope of this study. Traditional composting methods where only produce scraps are collected is far less costly, but very labor intensive. Additionally, students clear their trays very quickly at the end of lunch, and school staff expressed concerns about the increased time and oversight that would be necessary to ensure that

students appropriately separate compostable food scraps from their general refuse. For these reasons, the team could not provide enough support to ensure that composting initiatives were implemented consistently or correctly and this strategy was removed from the design of the pilot intervention.

The food recovery program initiated as part of this pilot was small in scale but was effective in providing some additional food to students who may have few resources and demonstrated the feasibility of implementing farther-reaching cafeteria-based food recovery. The program was well-received by students, likely because it addressed the basic moral concerns related to hunger in their community, as they discussed extensively in the formative study. Further, it offered an important opportunity for students to practice mindfulness skills. While students had understanding of their more extreme hunger and fullness cues, subtler cues are harder to notice and even the most experienced mindful eater sometimes needs more or less food than they anticipate. In this way, the program offered a learning opportunity for students by encouraging them to base their choices on their internal cues and the provision of the expanded share table offered a productive safety net for that opportunity; students who were hungrier than anticipated could take an extra serving of a healthy food (which in itself supported program goals) and students who realized they were comfortably full could donate unopened items in an environmentally and socially sustainable way in line with their values of reducing food insecurity.

The successes experienced in the development and pilot implementation of *FTTF* are encouraging and justify the program's expansion – altogether, the program was enjoyable and well-received for students, not burdensome for staff, and delivery was

feasible. Although disappointing, the challenges experienced were important lessons. It is not realistic to expect all strategies will be perfectly implemented, and the difficulties encountered highlighted ways to improve the program. Taken together, the pilot implementation achieved its goal by developing a feasible and acceptable program to target constructs in the behavioral model to explain eating behaviors of elementary school students.

Most importantly, the program was also able to demonstrate success in encouraging increased intake of fruits and vegetables while encouraging reduced plate waste among elementary school students. Success of *FTTF* was measured primarily by observing student lunches and surveying their attitudes and beliefs related to identified psychosocial constructs. While there were important baseline differences between the two schools that limit interpretation of findings to a certain extent, several positive and encouraging changes were seen during the study. Selection and consumption of produce increased among students at the intervention school and, although plate waste findings were more complex, it appears that student behaviors trended in the expected direction. Fruit waste appeared to decrease among intervention students during the intervention and the proportion of selected vegetables that was wasted decreased. Additionally, the energy and vegetable content of foods selected did not change during the intervention, but vitamin A content of plate waste decreased. Because levels of vitamin A are high among fruits and vegetables, the vitamin A content of waste could be an early indication of reduced vegetable waste. Fruit and vegetable intake, selection, and waste was measured in terms of servings but vitamin A was measured in international units, so it is possible that vitamin A was more sensitive to changes than the number of vegetable servings. It is

also reasonable to consider that, because vegetables were shown to be the least acceptable food group by this population, that it may take a longer time period to influence student vegetable consumption. There is clear evidence that increasing children's exposure to novel foods increases acceptance,[90,128] so continuing to encourage students to select more is a method to encourage them to voluntarily expose themselves to vegetables more frequently. This would increase their feeling of autonomy in choosing vegetables and give them more practice tasting and exploring these foods, hopefully resulting in increased willingness to try vegetables and reduced waste as a result.

Findings also indicate improved mindfulness skills among students. It was interesting to observe that students at the intervention school did not change their caloric consumption during the study, but that they selected and consumed more fruit when baseline and follow-up measurements were compared. Similarly, at follow up, they consumed a higher proportion of the vegetables they selected than did controls. Perhaps selection and consumption patterns of these students matched their energy needs at both time points but, at follow-up, they chose more nutrient-dense foods (i.e. fruit in place of snacks.) Consuming the same calorie level indicates students may be eating according to their hunger level and increasing their selection/consumption of fruit means they may be choosing foods that benefit them, both important mindful eating skills.

Further, students in the intervention school had improvements in psychosocial constructs related to mindful and sustainable eating behaviors during the intervention. Over the course of the study, students at the intervention school reported increased self-efficacy to base lunch choices on body cues, indicating they may have better understanding of mindful eating and awareness of their own needs. The regression

models showed that intentions to select and consume healthy foods is an important predictor of behavior, particularly as it relates to vegetable consumption and waste. While not uniform, these results indicate that the program was effective in improving attitudes and beliefs and that the model was at least partly correct in explaining mindful and sustainable eating behavior. Because psychosocial characteristics underlie behaviors, changes in attitudes and beliefs can be thought of as the impetus for behavior change;[40,41] recognizing the positive changes in constructs related to mindful and sustainable eating behaviors measured in the study indicates that a larger behavioral effect is possible. Additionally, it is possible that increased self-efficacy must occur before increased intentions are evident; since a person's intentions directly impact their behavior, placing extra emphasis on both of these constructs could encourage more demonstrable changes in behavior. Continued refinement of the survey and testing with a larger sample would be beneficial, as the present instrument had only been tested for comprehension/reading level in the sample and face validity by experts in the field. Repeat administration in the control group showed reliability for most items, but the tested sample was too small to demonstrate an underlying factor structure that matches the SCT. Nevertheless, the instrument from which the present survey was adapted[48] did support use of SCT to explain eating behavior in general, and improvements in some items in the present study, along with their relationships with dietary outcome measures is a positive result indicating improved mindful and sustainable eating behavior.

Interpretation of school-wide plate waste measurements was more limited, primarily because this measurement was less sensitive to changes. The first school-wide measurement, conducted at the intervention school, measured plate waste from 505

students – nearly the entire student body that ate a school-provided meal that day. Unfortunately, because of space constraints and the time involved with collecting and sorting food from that many students, measuring plate waste from the entire school was disruptive and burdensome for school employees. Specifically, it necessitated a foodservice worker stay late because trays were delayed when being returned to the dish room and pulled custodians and food service monitors away from their normal duties to help researchers collect trays from students so that tables could be cleaned in time for incoming waves of students. For these reasons, the remaining school-wide plate waste measurements collected lunch remnants from approximately one third of the student body, resulting in a more reasonable number of trays to handle in a timely and non-disruptive manner.

Still, results of school-wide plate waste measurements showed waste decreasing over time, which was a positive and expected result. Additionally, it was a highly visible activity and resulted in many conversations with students about the purpose of the measurement. Rather than using school-wide food waste audits in a research context, this activity might be better suited as a teaching tool. Incorporating it into the program as a way for student leaders to highlight the amount of plate waste generated at the school could benefit students by making the magnitude of food waste more apparent and highlighting the burden of dealing with waste, perhaps as an allegory for the burden that landfills pose for the environment.

7.2 Implications

Just as the problems that result from food waste and poor dietary intake are far reaching, improving student consumption at lunch and reducing plate waste that they produce confers a variety of benefits. Broadly, consuming more fruits and vegetables, particularly when increased intake is in place of snacks or other energy-dense options, will likely improve the nutritional status of students, improve their attitudes and preferences related to those foods, facilitate school foodservice programs in further improving the healthfulness of foods offers, and reduce the environmental impact of foods that students select. Decreasing plate waste offers additional benefits – by decreasing waste, schools will incur fewer expenses related to waste disposal and purchasing of foods that go uneaten, the environmental burden on landfills will be reduced, and more uneaten foods can be recovered for responsible uses.

The environmental threat of food waste is clear. Globally, nearly one third of all edible food is wasted,[26,132] and in industrialized countries, most of this waste is directly a result of consumption and foodservice practices.[26,132] Approximately 25% of freshwater and 20% of cropland are devoted to growing food that will ultimately be wasted,[132] and in the United States, roughly 25% of methane production results from food rotting in landfills.[26] Furthermore, most of this waste stems from discarding healthy foods - in the US, approximately 41% of avoidable waste occurs from fruits and vegetables,[19] accounting for approximately 22% of greenhouse gas emissions due to food waste.[20] Considering the volume of meals served through NSLP, reducing plate waste in this program has the potential to have dramatic and far-reaching environmental benefits.

Encouraging students to consume more fruits and vegetables in place of snack foods as a way to improve the healthfulness of their diets can have similar environmental benefits. Plastic and packaging waste in school cafeterias has been estimated to comprise almost 50% of cafeteria refuse,[133] and reducing the number of snacks consumed in the cafeteria would reduce this volume of largely non-recyclable material. Furthermore, heavily processed foods are inherently more energy-intensive to produce than fresh produce[134] and reducing their consumption at lunch would ease environmental burden posed by school meals. Adding composting to this program will result in still more environmental benefits. Composting would divert additional waste from landfills and, if maintained on school grounds, could be used in school gardens. Doing so would improve soil quality and garden productivity, while reducing transportation needs and fuel consumption related to hauling away cafeteria trash.

Perhaps the most important environmental benefit is the behavioral impact of encouraging mindful and sustainable eating on environmental outcomes. Habits learned in childhood may influence an individual's behaviors in adulthood,[7] and positive results seen in *FTTF* could be an important way to encourage children to internalize feelings of environmental stewardship. Left unchanged, current food waste behaviors will only continue to harm the earth, and more solutions are needed to prevent what is possibly irrevocable damage. Programs like *FTTF* could be part of a constellation of efforts to raise a generation of people who will find creative and effective solutions to ensure the sustainability of the food system and the planet in general.

FTTF has positive organizational benefits for schools as well, from both financial and societal perspectives. Waste disposal and hauling can present substantial yearly

expenses; recognizing that schools and school food service programs experience a multitude of financial obligations with limited funding sources, reducing costs incurred to dispose of avoidable plate waste could ease financial burdens experienced by these organizations. Beyond the financial implications, schools offer important social programs and are critical sites to address food insecurity among students; in addition to school meals, many have on-site food pantries, send supplementary food home for the weekend with "backpack pantry" programs, or utilize less formal means to meet the needs of vulnerable children.[135] Recovering foods from the cafeteria, as was done in *FTTF*, offers another avenue to assist these students, thereby supporting their food security and their ability to grow and learn.

The positive implications that *FTTF* holds for students are similarly important. School meals are intended to help students meet DGA[2] and are effective in addressing both childhood obesity and food insecurity.[136] New meal standards, through the HHKA, have improved the nutritional quality of school meals.[3] Positive changes in the school food environment, such as those encouraged through SL strategies, can further reduce risk of diet-related outcomes.[137,138] Fundamentally, school meals hold a central position as a part of a health-promoting school day; nutritionally-balanced meals provided at school support healthy physical development of children, create opportunities to learn and practice healthy behaviors, and provide the nutrients necessary for emotional, behavioral, and academic development.[4] As most plate waste in school meals is attributed to healthy foods, high rates of waste result in students consuming less than recommended levels of key nutrients, including vitamin A, vitamin C, iron, and fiber.[32,35] Because nutritional and related benefits can only be seen if the healthy foods offered to children

are actually eaten, plate waste in schools undermines all of the important benefits of school meals. *FTTF* was able to show many positive trends in its pilot implementation that indicate students are selecting, consuming, or on their way to improving their intake of many healthy foods offered at school. Already beneficial for the students who participated, expansion of the program has the potential to profoundly impact the health and achievement of school children more broadly.

The model of *FTTF* offers additional benefits for students, separate from the actual foods selected or consumed. A main strategy of the program was the use of student leaders. This is not only an efficient way to spread messages, but also offers a strategy for building leadership and peer modeling skills that are developmentally important for children. Leadership helps children to feel more satisfied and engaged, teaches them how to be an active member of a group, and provides a foundation for skills necessary as a civically engaged adult.[139] Promoting self-awareness, self-esteem, and decision-making are suggested techniques to build leadership skills in children,[139] all of which are fundamental aspects of *FTTF* through its use of mindfulness education, emphasis on building self-efficacy to make healthy choices, highlighting of available food options, and incorporation of opportunities to practice new behaviors. Emphasizing mentorship is an additional recommended strategy for building leadership skills.[139] In this way, *FTTF* offers a way to support this important attribute among all students in the school, not only those who participate as student leaders. Among elementary school children, activities that empower them – through demonstrating, practicing, and building new skills – foster personal development, improve their self-esteem, and increase their engagement.[140] These ideas of leadership and empowerment are consistent with concepts of ecoliteracy[57]

and supported by the emphasis on building awareness in mindfulness education. *FTTF* was successful in weaving these themes throughout the program and serves as a useful model for encouraging characteristics that will benefit the emotional and behavioral health of children, in addition to their physical health.

.

7.2.1 Limitations of *Farm to Tray, Tray to Farm*

While the potential positive implications of improving student intake and reducing plate waste at lunch are numerous, there are limitations inherent in this pilot implementation of *FTTF*. Unfortunately, the schools that participated were not entirely comparable, as the intervention school had a higher percentage of students who were FARM-eligible, was larger, and had a student body with a different racial and ethnic composition than the control school. It is certainly feasible to believe that these factors could influence intake. Students of different cultural background might have varying levels of acceptance of foods served in the cafeteria. Similarly, FARM recipients could have different dietary patterns than students who purchase school meals. It is possible that these students eat more school meals and fewer a la carte items, increasing their exposure to healthy foods served at school. Conversely, it is possible that FARM recipients experience some level of shame related to their meal status; although school meal programs are required to maintain confidentiality, eligibility could deter some students from participating if there is a social perception that eating school meals is a marker of the student's financial background. Finally, larger schools may have different logistical considerations than smaller schools, as a more crowded cafeteria could lead to longer lines, less time to eat, and less attention or assistance from cafeteria monitors.

These differences in school characteristics could have led to baseline differences in plate waste patterns and psychosocial variables observed.

Some issues with data collection were also experienced. Although a 2-hour training session was provided to data collectors, some photos were missing from baseline measurements, likely due to unfamiliarity with the camera equipment. Students whose pre-meal photo was missing were removed from the dataset as the foods that they selected could not be accurately determined. Fortunately, relatively few pre-meal photos were missing, and removal of these records did not dramatically reduce the sample size. There were a larger number of post-meal photos that were missing; rather than remove these records entirely, the average proportion consumed by other students in their school was imputed for each selected food. Because it was the result of data collector errors and not student characteristics, these data were considered to be missing at random and using mean values was thought to be a technique that was not overly conservative (for example, making the assumption that students ate 100% of each item selected) and would not introduce a source of bias so large that it would make the results less trustworthy. Still, these issues with data collection provided an extremely useful learning experience that allowed protocols to be improved for subsequent days and could be further improved with more experience and a larger implementation.

Similarly, because school-wide measurement yielded only a total weight of foods collected for each food group, per-student estimates of weight could be calculated but no variability was seen. As a result, this measurement was a somewhat crude way to evaluate waste at the school-level. School-wide measurements could be improved by conducting food waste audits more frequently and over a longer period of time. In the

pilot study, four measurements were taken at each site and fluctuation due to chance or external factors (like field trips or schedule changes to accommodate state testing) could have influenced results. These measurements were also extremely labor-intensive, especially considering the limited interpretation of results they provided. However, school-wide plate waste data was very helpful to depict plate waste patterns as the measurements are easily converted into charts and figures. This kind of information is more understandable for students than photos of individual plates, so this activity might be most useful as a teaching tool for students. Future audits that are organized by student leaders would be a useful strategy to bring visibility to the intervention, provide an opportunity for student leaders to talk with their classmates about food waste, and generate understandable data for use in the school.

Finally, the adapted mindful and sustainable eating questionnaire had some issues with reliability and validity. Because this instrument was adapted from an existing survey[48] that was constructed around the same behavioral theory as the present intervention, it is reasonable to believe that the adapted version supported the same general model. However, changing question wording can certainly change interpretation, and the adapted questions intended to measure a different aspect of attitudes and preferences related to healthy eating. Being able to demonstrate a similar factor structure as Dewar, et al.[48] would have provided good evidence to support the adapted version as a valid tool. The sample size of this pilot implementation and few questions per construct did not allow for confirmatory factor analysis of the instrument with interpretable findings, and repeat administrations (possibly with additional or differently worded items) would be beneficial to provide data to show that the survey measures the intended

psychosocial constructs. Additionally, while the adapted instrument showed reasonable evidence for repeatability and acceptable consistency among items of some constructs, overall reliability was not as high as was seen in its original form. Pilot testing of the instrument during focus groups was a useful strategy to ensure that included items were understandable for students of this age group and guidance from field experts improved face validity of the instrument overall, but ongoing work is needed to improve the instrument's ability to measure changes in psychosocial constructs related to mindful and sustainable behaviors of elementary school children. In particular, cognitive interviewing with students of the same age is recommended to examine their interpretation and relevance of items to the behaviors of interest.

7.2.2 Strengths of *Farm to Tray, Tray to Farm*

Despite these challenges, the pilot implementation of *FTTF* presented several strengths that support the findings and can help guide future interventions. Fundamentally, *FTTF* is one of the first programs of its kind. Although work has been done to identify and document factors related to waste behaviors in NSLP and the school breakfast program,[15,24,38] understanding of these behaviors remains somewhat limited and researchers have discussed the need for additional work in this area.[141–143] This program fills a clear need to advance understanding of child perspectives related to food waste and the effectiveness of approaches to reduce waste.

Additionally, the approaches used in *FTTF* represent a novel approach to nutrition promotion in children. Programs that emphasize the food system and sustainability-related concepts exist, particularly in the context of school garden and farm-to-school

programs. Similarly, mindful eating programs have been conducted in this population, although aside from the program that provided the basis for much of the current education curriculum (Foodie U[60]), most available mindful eating research addresses treating eating disorders or obesity. Because the general elementary school aged population would benefit from improved eating habits, broader strategies to promote mindfulness with a weight-neutral approach are more useful in the present context. *FTTF* is unique in its approach of combining sustainability and mindfulness and the researchers are not aware of any previously existing interventions that have done this. By building on the expanded model of mindful eating proposed by Fung, et al[100] that emphasizes sustainability as inextricably linked with mindful eating, utilizing strategies/curricula that have been previously tested, and basing the program on an extensively-researched and widely accepted behavior change theory (SCT), *FTTF* represents an innovative, effective, and evidence-based model for improving dietary intake and reducing plate waste among elementary school students.

The methodology used for data collection in *FTTF* represents another important strength of this research. The methods used throughout the design, implementation, and evaluation of the program were based on structured approaches recommended by prominent methodologists. Strategies for data collection and analysis of the formative study were based on grounded theory and the constant comparative method to inductively develop a behavioral model to explain behavioral phenomena, about which relatively little research exists. In addition, data were solicited using a mixed-methods triangulation approach to consolidate and add credibility to findings from multiple sources and viewpoints. These tactics add a great deal of structure and repeatability to qualitative

research, which can suffer from biases and lack of rigor when not designed carefully. Methods used to measure plate waste were intended to replicate methods described in previous studies to estimate plate waste in schools. Similar to the identified need for research on effective approaches to address plate waste, there has been a call for research to replicate data collection methods to help create standardized measurement and reporting methods.[144] The present study helps to address this need.

Finally, although the pilot implementation of *FTTF* was relatively small, with limited reach and generalizability, it yielded a number of highly encouraging results. After participation, students had increased selection and consumption of some target healthy foods, trends toward reduced plate waste of others, and positive changes in important psychosocial constructs – together, it appears students who received the intervention were more mindful of their food choices and more aware of sustainability considerations of food waste than they were previously. Additionally, the program was well-received by the schools, well-liked by students, and, aside from significant labor involved with data collection, relatively inexpensive and easy to implement. With this in mind, the greatest strength of *FTTF* may be the design of the program itself. The program can be implemented in other settings easily by educators or researchers, and the positive results certainly warrant larger, more intensive implementations.

7.2.3 Considerations for Future Interventions

Interpretation of pilot findings highlights a number of considerations that are recommended for future implementations, whether as part of a school initiative or research study. Researchers who test the program should aim for a longer duration

program with more frequent contact with students; this would allow for better understanding of the most effective strategies so they could be prioritized in order of importance, and likely a greater effect overall. Similarly, a larger sample size would allow for examination of the survey using structural equation modeling or confirmatory factor analysis; doing so would provide evidence to identify the most important constructs, as well as relationships among constructs, so that the program can efficiently address those that are the most influential. Finally, as discussed previously, additional work should be done to improve items included in the mindful and sustainable eating behavior questionnaire to build evidence supporting the reliability and validity of this instrument.

Schools that wish to implement *FTTF* should specifically consider sustainability of the program. Because systemic change takes a great deal of time, making aspects of the program a permanent part of the school culture would ultimately cause greater benefits for students and the school community. There are a variety of ways to incorporate the program into the school culture, such as creating a permanent club for Veggie Leaders. An interested member of the school faculty could spearhead such an initiative and serve as the club's advisor. Formative research indicated that some school districts offer financial incentives for staff who participate in wellness-related activities outside of their normal job duties, and support may be available for an individual willing to take on this role. Similarly, as schools are required to have written wellness policies to support the health and wellness of students and staff, incorporating some strategies used in *FTTF* into the school's policy would increase the program's reach and effectiveness. Mandating cafeteria-greening initiatives, like strategies to reduce plate waste or

encourage students to select food that is less resource-intensive to produce, or incorporating cafeteria-based food recovery initiatives by incorporating these approaches into written policies would help schools prioritize the resources necessary to support these strategies and provide long-term benefit for the school community.

Finally, lessons learned from this program and child development research highlight the powerful influence of peer leaders. In light of this, schools should consider creating structured mentorship programs. For example, schools could have older and younger students eat together in the cafeteria, offering an opportunity for the older child to develop leadership skills and self-confidence and for the younger child to identify a role model from whom they can learn important concepts through observation and practicing new behaviors. Such a program would not only encourage students to practice mindful and sustainable eating behaviors, but also promote positive development of children and help to create new social norms within the school community.

7.3 Conclusion

The design, implementation, and evaluation of *FTTF* represents an extensive research effort, but more importantly, the result of collaboration with a school system chiefly focused on creating an environment for their students that was as educational, supportive, and nourishing as possible. Through their generosity, accommodation, and willingness to actively participate in the pilot study, the researchers and educators involved were able to work together to create a program that is effective to support mindful and sustainable eating behaviors of children. Successes seen as a result of *FTTF* are largely due to the cooperation of school staff, who are motivated by a fundamental drive to guide healthy child development and possess the vision necessary to understand

the long-term possibilities of small changes. Because of the ease of implementing the pilot version in this school system, *FTTF* was able to achieve improved intake and trends toward reduced waste among elementary school students, providing evidence that supports an emphasis on mindful and sustainable eating behaviors to encourage healthier diets with reduced environmental impact.

APPENDICES

This section includes tools, materials, and forms used throughout the study. Specific data collection instruments contained in the appendix are:

1. Guide used to conduct semi-structured in-depth interviews with school staff in the formative study
2. Guide used during focus groups with 3rd – 5th grade students in the formative study
    2.1. A brief demographic survey administered for focus group participants
3. Survey to measure mindful and sustainable eating behavior, adapted for use in this study

The remaining appendix contents includes protocols used to train research assistants who conducted observations of individual student meals and food waste audits, followed by all announcements and consent forms used for recruitment and enrollment of study participants. Additionally, the training protocols for research assistants includes data collection forms used during the pilot study.

Appendix 1: In-depth Interview Guide

Plate Waste Reduction in Elementary Schools

In-depth Interview Guide

(school nutrition personnel and administration)

I. Project Introduction

Thank you very much for agreeing to speak with me today! Is this still a good time for you to talk?

As I mentioned when we set up this interview, I am a graduate student at the University of Maryland. I am interested in studying eating and food waste behaviors during school lunch and during this interview, I'd like to ask you for your thoughts about what you observe in your school. I'm also interested in any logistical considerations that affect what foods students choose and how much they throw away. I expect that our conversation will take about 30-60 minutes, but I will let you know after thirty minutes are up if we aren't quite finished yet – I want to make sure that I am respectful of your time.

I have a variety of questions in mind, but any information you would like to share with me will be valuable. I'd like to remind you that your participation in this interview is completely voluntary, and if you choose to participate, you are free to stop at any time. Everything that you share with me will be confidential – I will not share your name or any of the information you provide with anyone outside of this study. Would you like to continue?

So that I can remember everything that we talk about, I'd like to ask your permission to record this conversation. I will delete the tape after I make a transcript. Is this OK with you?

[If the interviewee does not object, start the recorder; otherwise, plan to take notes and reiterate that all information is confidential.]

Just to verify, you are the [job title] at [program name], is that correct?

Thank you. How many years have you been at [name of school]? Could you please briefly describe your overall role?

[Complete section II for school nutrition personnel; otherwise skip to section III]

II. *First, I'd like to get a better understanding of how lunch at your school is structured.*

a. Can you please tell me what time lunch is served in your school?

b. Are the students split into different lunch periods or waves? How long is each period?

c. How long does it typically take students to go through the tray line?

d. Do you often have to ask students to take more or different items so they have a reimbursable meal? How often? How much effort do you have to give to make sure students have the required components?

e. Can you please describe what the interaction with students is like when they are in the tray line? *[prompt: Which foods do they choose? How many options do they choose from?]*

f. Do you ask for feedback from students about the food? How?

    i. How is that feedback used in menu planning?

ii. Which foods do the students seem to like the best? Which do they like the least?

[Proceed to section IV to continue interview with school nutrition personnel]

[Complete section III for members of the school administration/other faculty]

III. *First I'd like to get a better understanding of how lunch in your school is structured.*

a. Can you please tell me what time lunch is served in your school?

b. Are the students split into different lunch periods or waves? How long is each period?

c. Is lunch monitored by anyone outside of the cafeteria staff? What kind of interaction do they have with students?

[Complete the remaining sections for all participants]

IV. *I'm also interested in hearing your thoughts about the food that is thrown away during lunch at your school.*

a. It sounds like your school works very hard to provide the students with good, nutritious meals. What is your opinion on the *quality* of food that is served? Do you eat any of the food served to students? What do you like and not like about it?

b. About how much food do you think is thrown away at lunchtime? (Do students eat most of their meals and throw away little food? Do they throw away a lot of their meals? Are most of the foods that they throw away healthy, like fruits and vegetables?)

c. Do you think students eat enough healthy food during lunch? Do you think they know enough about what healthy eating is?

d. Do you think the amount of food that your students throw away is a problem? What about the type of food that students throw away?

e. In general, do you see any problems related to throwing away food?

f. Why do you think people throw away food?

g. Why do your students throw away food (if they do)?

V. *I am thinking about creating a program to try to reduce food waste, so I'd like to get your input about this kind of program – and if you see any major problems or challenges.*

a. Some of my ideas are to use a curriculum to teach students about nutrition, the environment, and about mindfully choosing and eating food that is healthy for them and more sustainable for the planet. We are exploring different ways to do this and also the possibility of using either peer leaders or mentors to teach some of these concepts. Do you think your students would be interested in learning about these topics? Do you think they would be interested in learning from their peers?

b. Would it be possible to have a program like this at your site?

    i. What kind of time commitment would be possible?

    ii. **Ask to school administration/faculty:** Do you think there is any possibility that lessons such as these could be coordinated with the school curriculum (perhaps through science class?) If so, what would make that feasible?

iii. If it is not reasonable to have these lessons be classroom-based, what time of day do you think would work best for delivery? After school? During lunch? Some other time during the day?

iv. Do you think there is anyone who works at the school or is part of the PTA that might be interested in helping with this kind of program? (Maybe someone on a wellness committee?)

c. Most of my ideas for this program involve working with students (by teaching them about food and nutrition, encouraging them to finish their fruit and vegetable, etc.), but are there any "behind the scenes" changes that you think would be helpful in encouraging students to throw away less food? *[Prompt: For example, do you think it would be reasonable to change anything about how food is served? Is that necessary or important? Is there anything about the way the cafeteria is set-up that should or could change?]*

d. Can you think of any logistical barriers to having a program like this at your site?

e. Can you think of any barriers related to student interest to having a program like this at your site?

f. If I could address all of the logistical problems that you described, what kinds of things could I do to make sure students enjoy and are engaged with a program like this?

g. Can you think of anything else that would make a program like this successful?

h. Can you think of any other needs of your school's lunch program that I could address?

VI. Closing

Thank you very much for answering my questions – this was very helpful, and I really appreciate your time and input. Do you have any questions for me or anything else you would like to add?

Appendix 2: Focus Group Guide

Plate Waste Reduction in Elementary School Cafeterias

Focus Group Protocol

(3^{rd}-5^{th} grade participants)

I. Project Introduction

Thank you all for coming today! I'd like to start by briefly introducing myself. My name is Amy and I am a graduate student at the University of Maryland. I am interested in studying what people your age think about when they get lunch in the cafeteria – specifically, I'd like to find out what foods you choose and why, and any ideas you have about why kids sometimes throw away their food.

We are here for what's called a focus group – this is for us to brainstorm ideas as a group, so I'd like to ask you to please share your ideas and listen to the ideas that others share as well. Anything you have to say will be helpful for me. You should also know that everything we talk about is confidential, which means that I won't tell anyone your names or anything that you said to people that are not working on this project. Your participation today is completely voluntary, which means that if you decide that you do not want to participate any more, you are free to leave the conversation. Does everyone want to continue?

[Continue if there are no objections.]

So that I can remember everything that we talk about, would it be OK if I record our conversation?

[If no one objects, start the recorder; otherwise, plan to take notes and reiterate that all information is confidential. If recording, explain that the tape will be deleted after it is transcribed.]

II. Participant Introduction

Before we begin, I would like to collect some very simple information from each of you. Could you please fill out this piece of paper? [Distribute demographic survey]

Thank you! Do any of you have any questions?

III. Discussion Topics

As I mentioned before, I am interested in learning about food that people throw away – but first, I'd like to hear what you know and think about a few different things. [Move through prompts below as a general guide.]

a. Student perception of healthy eating

i. Can anyone tell me what they think healthy eating is? *[If no one has a clear idea can prompt: Is healthy eating having fruits and vegetables? What other kinds of foods are healthy for us? Hold up a few images (one with fruits and vegetables, one with junk food, one with a balanced meal) – are any of these healthy? Which is healthiest? Why?]*

ii. How do people know how much food they should eat? Do we need the same amount every day or does it change? *[Prompt: Do people need more food when they are growing? Do they need more food when they play a lot?]*

iii. How do people know when they have eaten the right amount of food?

iv. Is it easy or hard to know how hungry or full you feel?

v. Do the foods that you want to eat change when you feel more or less hungry?

vi. Are there any things that make it tougher to know how hungry or full you are? *[Prompt: What about when it's noisy in the cafeteria? Or when you're in a hurry?]*

b. Causes for plate waste

i. Why do people throw away food? *[Prompt: Is it because they're full? Is it because they don't like the food? Do they not have enough time?]*

ii. Why do you throw away food?

iii. Do you think people usually throw away a lot of food? How much is a lot? *[Visual prompt: pictures of trays with various amounts of food – Are any of these a lot of food? A little food? Do you think any of these pictures show an amount of food that kids your age throw away?]*

iv. What foods do you think kids throw away the most at school? Why are these the foods that kids throw away? *[Visual prompt: pictures of different food groups served during lunch – Which of these foods do you think kids throw away the most often? Why do they*

throw those foods away? Does it have to do with how much they like the food or something else?]

v. Do you think most of the food that kids throw away is healthy for them? Are there any ways to help kids like some of those healthy foods better?

vi. What do you think about throwing away food? Is it good or bad? Does it depend on what kind of food it is?

c. Understanding of sustainability

i. I'm curious if any of you have heard of a few different words – [visual prompt with words printed out (say word out loud as each is held up): environment, recycling, compost, sustainability]. Does anyone have an idea of what any of these words mean? Are the things that these words mean important? *[If no one has an idea can say: Sustainability is a big word, so let's talk about that one. I think sustainability is an idea that means we change the way we do things so that we don't run out of what we need to do them – kind of like when people have a car, they have to put gas in and take care of their car so it keeps working. A lot of the time, people think about sustainability of the planet – and how we should take care of the planet so it stays a nice place to live."]*

ii. Does anyone think about ways to take care of the planet? What are some of the ways?

iii. Does anyone think that what we choose to eat is related to how we take care of our planet? Are some foods better for the earth than others?

iv. What about the food that we throw away, is that related to how we take care of our planet? How?

So, one thing I would like to do is to help people eat healthier and throw away less food. Does that sound important to any of you? Does anyone have any ideas of ways we can do that with kids your age? [Move through prompts below or let conversation develop if productive.]

d. Strategies to reduce food waste

i. Can you think of any ways to encourage kids to eat more fruits and vegetables at lunch?

ii. Can you think of any ways to encourage kids to throw away less food in general? *[Visual prompt – hold up reduce, reuse, recycle sign: Have you heard of the idea of reduce, reuse, and recycle? If you think about that idea, can you think of any ways to throw away less food?]*

iii. Can you think of ways to encourage kids to throw away less of their fruit and vegetables?

1. Why do you think these ideas will work?
2. Can you think of any reasons why these ideas might not work?

iv. Can you think of anything that would make it hard for kids that might want to throw away less healthy food? *[Prompt: Do you think their friends would think it was weird? Do you think they might not have enough time to eat?]* Is there anything that would make it easier?

v. I am thinking about making a program to try to help kids eat healthier by helping them learn how hungry or full they are and what foods are healthy for us and the planet. We'll do a lot of activities and have a lot of chances for the kids that join us to show your school the things they learn. Is this something you would like to do?

    1. Do you think the other kids in your class would like this program?
    2. Can you think of ways to include the ideas you just brainstormed?
    3. What are some ways that I could make a program like this more fun?

vi. Have you had any classes or programs about food or nutrition before? What did you like and not like about them?

IV. Closing

Thank you, that was very helpful! Does anyone have anything else that they would like to add before we say goodbye?

Appendix 2.1: Demographic Survey for Focus Group Participants

Background Information

Please fill in this paper and raise your hand if you would like to ask a question!

What is your first name?

_____

How old are you? _____

What grade are you in?

- ☐ 3rd grade
- ☐ 4th grade
- ☐ 5th grade

Do you buy lunch at school?

- ☐ Yes
- ☐ No

If yes, how often do you usually buy lunch at school?

- ☐ Almost every day
- ☐ 3 or 4 days a week
- ☐ 1 or 2 days a week
- ☐ Less than once a week

Appendix 3: Mindful and Sustainable Eating Behavior Questionnaire

Eating Behavior Survey

These questions ask about how you eat. There are no right or wrong answers. Please read carefully and think about which answer best describes you.

Please tick (✓) the ONE option that is true about what you ate yesterday

Yesterday, did you eat French fries or chips? Chips are potato chips, tortilla chips, cheetos, corn chips, or other snack chips.

- ☐ No, I didn't eat any French fries or chips yesterday.
- ☐ Yes, I ate French fries or chips 1 time yesterday.
- ☐ Yes, I ate French fries or chips 2 times yesterday.
- ☐ Yes, I ate French fries or chips 3 or more times yesterday.

Yesterday, did you eat any vegetables? Vegetables are salads; boiled, baked and mashed potatoes; and all cooked and uncooked vegetables. Do not count French fries or chips.

- ☐ No, I didn't eat any vegetables yesterday.
- ☐ Yes, I ate vegetables 1 time yesterday.
- ☐ Yes, I ate vegetables 2 times yesterday.
- ☐ Yes, I ate vegetables 3 or more times yesterday.

Yesterday, did you eat beans such as pinto beans, baked beans, kidney beans, refried beans, or pork and beans? Do not count green beans.

- ☐ No, I didn't eat any beans yesterday.
- ☐ Yes, I ate beans 1 time yesterday.
- ☐ Yes, I ate beans 2 times yesterday.
- ☐ Yes, I ate beans 3 or more times yesterday.

Yesterday, did you eat fruit? Do not count fruit juice.

- ☐ No, I didn't eat any fruit yesterday.
- ☐ Yes, I ate fruit 1 time yesterday.
- ☐ Yes, I ate fruit 2 times yesterday.
- ☐ Yes, I ate fruit 3 or more times yesterday.

Please tick (✓) ONE option to indicate how much you agree or disagree with each statement.

When I eat lunch at school…	Disagree a lot	Disagree	Disagree a little	Agree a little	Agree	Agree a lot
…I find it difficult to know how much food I am hungry for.	☐	☐	☐	☐	☐	☐
…I find it easy to notice when I am starting to get full.	☐	☐	☐	☐	☐	☐
…I believe I can decide how much food is the right amount for me.	☐	☐	☐	☐	☐	☐
…I find it difficult to eat an amount of food that's right for me when I eat with my friends.	☐	☐	☐	☐	☐	☐
…I find it easy to finish my fruit.	☐	☐	☐	☐	☐	☐
…I find it easy to finish my vegetable.	☐	☐	☐	☐	☐	☐

Please tick (✓) the option that best describes how you feel about ways you will act in the future.

In the next THREE MONTHS do you…	Not at all true of me	Mostly not true of me	A little true of me	Very true of me
…INTEND to finish your fruit at lunch?	☐	☐	☐	☐
…INTEND to finish your vegetable at lunch?	☐	☐	☐	☐
…INTEND to think about how hungry you are before eating lunch?	☐	☐	☐	☐
…INTEND to think about how the foods you eat help or hurt the Earth?	☐	☐	☐	☐

Please tick (✓) ONE option for each question that best describes how you have acted in the <u>PAST</u>.

In past THREE MONTHS did you…	Never	Rarely	Some-times	Often	Always
…think about how hungry you were before choosing food at lunch?	□	□	□	□	□
…think about where your food came from?	□	□	□	□	□
…try to focus on eating during lunch so you would have time to finish?	□	□	□	□	□
…think about whether the foods you chose were good for you?	□	□	□	□	□

Please tick (✓) ONE option to indicate how much you agree or disagree with each statement <u>and</u> how important each statement is to you:

Thinking about how hungry I am can help me eat healthier.					
□ Disagree a lot	□ Disagree	□ Disagree a little	□ Agree a little	□ Agree	□ Agree a lot

How important is eating healthier **<u>to you</u>**?			
□ Not at all important	□ Only a little important	□ Important	□ Very important

My body gives me cues that help me decide what to eat.					
□ Disagree a lot	□ Disagree	□ Disagree a little	□ Agree a little	□ Agree	□ Agree a lot

How important is listening to your body cues **<u>to you</u>?**			
□ Not at all important	□ Only a little important	□ Important	□ Very important

Understanding where food comes from (how it is grown, produced, or made) helps me eat healthier.					
□ Disagree a lot	□ Disagree	□ Disagree a little	□ Agree a little	□ Agree	□ Agree a lot

How important is understanding where food comes from **<u>to you</u>?**			
□ Not at all important	□ Only a little important	□ Important	□ Very important

Appendix 4: Pilot Project Data Collection Protocols & Training Materials

Mindfulness-Based Food Waste Reduction Pilot Trial

Research Assistant Training

Contents

---

1. **Individual plate waste data collection**

Individual plate waste will be measured at the study baseline and follow-up at two schools, one control and one intervention. The schools and tentative dates are:

Intervention School: Baseline data collection: January 15th – 17th, 2019

Follow-up data collection: May 21st – 23rd, 2019

Control School: Baseline data collection: January 22nd – 24th, 2019

Follow-up data collection: May 28th – 30th, 2019

Individual plate waste will be measured using the digital photography method. In this method, standardized photographs are taken of the student's tray before and after he or she eats. The tray is manipulated after the meal by the data collector so that all components are visible in the photo and any items that are not visually estimable are separately weighed. Evaluation of the photographs will take place at a later date.

2. **Data collector's responsibilities and role**

You are responsible for consistently taking measurements from students and for attempting to collect data from as many willing students as possible. It is important that we obtain as large of a sample as possible, but no students are mandated to participate. Please be polite and friendly and try to be as efficient and unobtrusive as possible.

Although we will not be handling students' lunches before they eat, please also ensure that you follow food safety guidelines: wash hands thoroughly, wear food handler gloves, and restrain hair (if applicable.)

a. **Procedure**

   i. Prior to lunch: Please weigh 3 samples of each non-packaged food item to be served that day and record on the data collection form. Cafeteria staff will assist with this task (if they are available) so that these items can still be served to students. If for some reason it is not possible to do this before lunch, weights can be taken after lunch (**this is a back-up option only as some items may sell out or their weights might change due to the items drying out while sitting**)

   ii. Lunch times are staggered according to grade. We will take measurements from up to four classes during each day of data collection. You will be provided with a schedule in advance.

   iii. Students will already know that the study is taking place and will come to lunch with an ID card given to them by their teacher.

   iv. After picking up their lunches, students will place their tray on a mat at our photo taking station (set up at the exit of the tray lines).

1. If the students ask why we are photographing their lunch, tell them that we are studying what kinds of foods children their age eat or that we are studying what kind of foods children their age throw away. Please do not specifically mention that we are studying which or how many vegetables they eat.
2. If they have not already done so, please ask the students to place their tray on the mat and make any adjustments as needed to center the tray in the marked area.
3. Place the student's ID card, survey, and pencil on the tray, ensuring that the ID number is visible.
4. Ensure that the camera is set up according to specifications and take the pre-meal photo.

v. Trash cans will be removed from their normal location at the end of the class's lunch table.

vi. As the class is nearing the end of their lunch period, roll the camera station, the tray cart, and a trash can to the end of the class's table.

vii. When students finish eating, those who are participating will again place their tray on the mat to be photographed.

1. Ask students who are not participating to hand you their tray (so that you can discard its contents) or allow them to dispose of their waste themselves.
2. Ask students who are participating for their completed survey and pencil, and then the student may leave. Data collectors are then

responsible for making adjustments, taking the photo, recording weights of certain items, and disposing of the tray.

3. To make adjustments to the tray: Remove and dispose of any non-edible items (napkins, utensils, peels, etc.) that obscure edible portions of food. For solid foods that are inside of an opaque container (i.e. chips in a foil bag), pour the contents directly onto the tray and dispose of the container. For liquid foods inside of an opaque container (i.e. milk or juice), please weigh the item on a food scale and record the item, its weight, and the student's ID number on the data collection form.
4. Food items in a disposable serving cup (i.e. salad, cut vegetables) should not be manipulated except for removing the lid if necessary. Serving cups are useful for estimating the proportion of the item that remains.
5. Write the student's ID number on the survey.
6. Dispose of the tray's contents after taking all measurements. Stack trays and return to the dishwashing area of the cafeteria.

viii. *When taking measurements from young students*: Younger students, specifically those in kindergarten and 1st grade, might not be able to read and complete the survey! I will circulate during lunch and help these students answer the questions, but please be prepared to verbally ask the questions to students who have not completed the survey.

ix. *If the post-meal procedure is taking too long*: If time does not allow for the procedures above to be conducted as students conclude their lunch period, please collect trays and surveys from students and place the unmanipulated trays on a rack. Doing this allows the trays to be photographed and weighed after students exit the cafeteria.

b. **Division of labor**

We will attempt to have two research assistants plus the PI present on all days of data collection. Please be familiar with all tasks in case we need to occasionally switch roles, but plan for the following:

Before lunch

RAs #1, #2, and #3: Set up camera station according to specifications

PI: Bring all materials, communicate with cafeteria/school staff, obtain equipment from cafeteria

Pre-meal photos

RA #1: Greet the child, ensure the tray is in the correct position, wait for RA #2 to place ID card, survey, and pencil, and take the photograph

RA #2: Place the ID card on the tray ensuring that the ID number is face up (if the child has not already placed it); put survey and pencil on the tray, ensuring that no food items are covered

RA #3: Serve as a "float" – please step in if either RA #1 or RA #2 need a break, are overwhelmed, need supplies, etc

PI: Supervise photo-taking and assist if needed, greet students entering the tray line and remind them of data collection/right to opt-out, communicate with cafeteria/school staff throughout process

While students are eating

RAs #1 and #2: Roll camera station, tray rack, and trash can to end of class's lunch table

RA #3: Keep track of time and when the next class will be arriving; if time allows, help young students complete surveys

PI: Coordinate with custodian to empty trash, return used trays to dishwashing area, help catch up with measurements if back-ups occur

Post-meal photos

RA #1: Greet the child, ensure the tray is in the correct position, wait for RA #2 to manipulate tray and take weights, and take the photograph

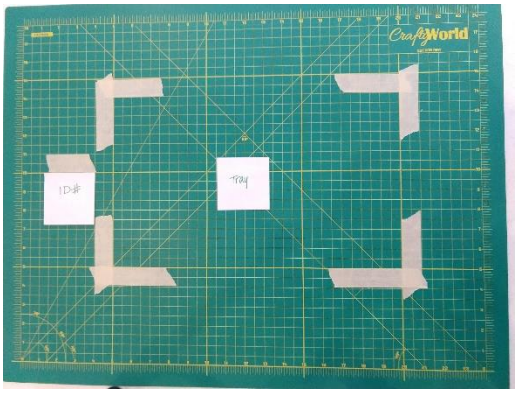
RA #2: Remove in-edible items and discard; remove non-visual items, weigh, record weights, and return to tray for photo

RA #3: Collect survey and pencil (and verbally ask questions, if necessary), write ID number on survey; assist RA #2 with weighing non-visual items if feasible

PI: Supervise photo-taking and assist if needed, assist with weighing if line backs up, collect and discard items from students who are not participating

c. **Photo station set-up**

i. Place mat with guidelines on the rolling cart



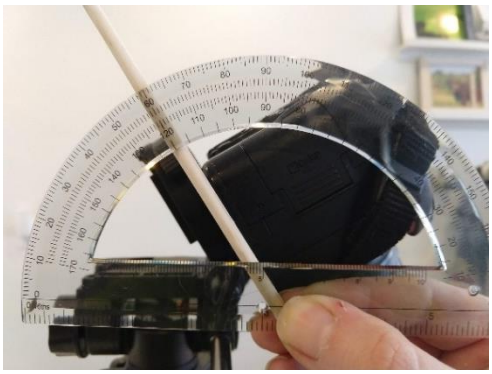
We will use an 18x24” cutting mat as the backdrop for the photos. Trays should be placed inside of the masking tape outline and ID cards should be placed on top of the post-it labeled “ID #.”

ii. Attach camera to tripod

The easiest way to do this is to remove the camera plate from the tripod using the quick release lever. The plate can then be screwed into the threads on the underside of the camera and attached back onto the tripod. Please make sure the quick release lever is secure after replacing the camera. Plate the camera and tripod so that two of the tripod’s feet touch the mat and are roughly centered.

iii. Set up tripod so that camera is 22” above the mat (this is the lowest setting on the tripod). Check that the camera is level, then tilt forward to a 60° angle (use the protractor to check.) Look through the viewfinder and zoom in or out to capture the entire mat in the full field of vision. Tighten all nuts to ensure camera will remain in a stable position.

Use the level to ensure the camera level – the bubble should be between the two black lines



Use the protractor to measure the camera’s forward tilt

iv. Periodically check viewfinder to ensure entire tray is visible and that camera is at the correct height/angle

v. Periodically check camera battery to ensure it is charged. Additional batteries are available in case it runs low. Please do not let the battery run out completely.

vi. Place food scale off to the side.

vii. Have available: extra food handler gloves, box of blank surveys, box of sharpened pencils, box to collect completed surveys, extra ID cards, camera battery charger, clip boards, data collection forms, pens/pencils

3. **School-wide plate waste data collection**

School-wide plate waste will be measured at the study baseline and follow-up at the two schools, and monthly during the intervention. Tentative dates are:

Intervention School: Baseline data collection: Week of January 28th, 2019
Follow up 1: Week of February 19th, 2019
Follow up 2: Week of March 18th, 2019
Follow up 3: Week of April 23rd, 2019
Final follow up: Week of May 28th, 2019

Control School: Baseline data collection: Week of February 4th, 2019
Follow up 1: February 25th, 2019
Follow up 2: March 25th, 2019
Follow up 3: Week of April 29th, 2019
Final follow up: Week of June 4th, 2019

School-wide plate waste will be measured using an adapted version of the EPA's Guide to Conducting Student Food Waste Audits. This method will allow us to identify patterns in food waste from a larger sample of students and track changes over the course of the study. We will collect trays from students as they finish lunch, quickly interview students if possible, and separate their plate waste into buckets for each food group.

Activities that will be involved in this context are: planning, set-up, data collection (measuring the weight of food waste and collecting brief survey data from students), and data analysis.

a. Materials and set-up

It is very important that the data collection station be very organized – students move very quickly when disposing of the contents of their trays and leaving the cafeteria, so there won't be enough time to move around or interact with students if the set-up is unclear. The PI will bring/arrange for the equipment and materials to be available, but please be familiar with the following:

i. At least one table for sorting items into buckets
ii. At least one rack to stack and store trays until ready to sort food into buckets (this is not included in the EPA guide).
iii. Large wheeled trash cans to empty food buckets after they are weighed (minimum 2)
iv. 6 five-gallon buckets labeled as: meat/meat alternative, grain, dairy, fruit, vegetable, a la carte items/snacks
v. Small trash bags to line buckets
vi. High accuracy food scale (plus luggage scales as a back-up) to weigh buckets

vii. Weight logs

viii. Gloves and utensils (i.e. spatulas) for handling food

ix. Aprons

x. Cleaning supplies

b. Review EPA guide page 7: Instructions for food separators

Our procedures will again differ slightly from the EPA guide.

xi. Buckets should be arranged on the table with the labels clearly visible. Line the buckets with the small trash bags.

xii. All data collectors will move to the end of each table as students are preparing to finish their meal. Students will circulate the table, as they normally do to discard their lunches; instead, please collect trays from students and place them on the rack. Repeat with other classes. When all trays from an entire grade have been collected, wheel the cart or rack to the food separating station.

xiii. Separate items into their corresponding bucket: the first 5 buckets are based on components served as part of school lunch (meat/meat alternate, grain, dairy, vegetable, and fruit). Any other edible items purchased in the cafeteria (chips, ice cream, etc.) should be placed in the a la carte/snacks bucket. All inedible items (napkins, utensils, wrappers, cores, peels, etc.) and foods brought from home should be discarded.

xiv. As the large trash can is becoming full, exchange it with the second trash can so the custodian can empty it.

xv. After lunch is over and all buckets have been separated/discarded, thoroughly clean the station and pack up all belongings. Thank the custodian, lunchroom monitors, and cafeteria staff profusely for their assistance.

4. Surveys and data collection forms

a. Individual plate waste survey

Thank you for participating!

Please fill out this paper before you leave the cafeteria!

How hungry or full were you <u>before lunch started</u>?

☐	☐	☐	☐	☐	☐
Too hungry	A little hungry	Just right	A little full	Too full	I don't know!

How hungry or full are you <u>after eating lunch</u>?

☐	☐	☐	☐	☐	☐
Too hungry	A little hungry	Just right	A little full	Too full	I don't know!

Did you like what you had for lunch today?

☐	☐	☐	☐	☐	☐
I didn't like it at all	I didn't like it a little bit	It was OK	I liked it a little bit	I liked it a lot	I don't know!

b. Individual plate waste pre-meal weight log

Pre-Meal Weights				
Part 1: Foods cooked/assembled in cafeteria Use metric units and record weights to the nearest 10th of a gram.				
Food item	**Sample 1 weight**	**Sample 2 weight**	**Sample 3 weight**	**Average**
Part 2: Packaged foods served in cafeteria Record all food items and record weight listed on package				
Food item	**Weight**			
Part 3: Tare weights Weigh all serving containers used in the cafeteria. Use metric units and record weights to the nearest 10th of a gram.				
Container	**Weight**			

c. Individual plate waste post-meal weight log

Post-meal weights of items not visually estimable Weigh items in their container, then discard contents and weigh empty container Use metric units and record weights to the nearest 10^{th} of a gram			
ID Number	**Food item**	**Weight in container**	**Weight of empty container**

d. School-wide plate waste weight log

School-wide Plate Waste Weight Log

Weigh bags as buckets are filled or when each grade is finished discarding trays, whichever occurs first. Count and record the number of trays returned for each grade.

Use metric units and record weight to the nearest 10^{th} of a gram.

Bag tare weight: _____

Meat/meat alternate		Grain		Dairy		Fruit		Vegetable		Snacks/a la carte	
Grade	Weight	Grade	Weight	Grade	Weight	Grade	Weight	Grade	Weight	Grade	Weight
Number of trays from each grade											
K:		1st:		2nd:		3rd:		4th:		5th:	

Appendix 5: Recruitment and Consent Forms

Appendix 5.1: Informed Consent for Interview Participants

CONSENT TO PARTICIPATE

Project Title	***Formative Research to Design a Theory-driven Intervention to Reduce Food Waste in Elementary Schools***
Purpose of the Study	*This research is being conducted by **Amy Schachtner-Appel** at the University of Maryland, College Park. We are inviting you to participate in this research project because you an administrator or school nutrition personnel at a Caroline County elementary school. The purpose of this research project is to understand food waste behaviors of children during school lunch. The results will be used to design a program that will attempt to reduce food waste generated during school lunch in Caroline County public elementary schools.*
Procedures	*The procedures involve interviewing school staff and administrators to understand the practical implications, logistical challenges, staff-reported perception of a proposed intervention program to reduce food waste. The researchers would like to record the interview for transcription purposes, but this is not mandatory for participating in the interview. The interview is expected to take 30-60 minutes.*
Potential Risks and Discomforts	*There minimal to no risks from participating in this research study. Participants may experience some discomfort when answering questions, but will be reminded that participation is voluntary.*
Potential Benefits	*There are no direct benefits from participating in this research. We hope that, in the future, other people might benefit from this study through improved understanding of food waste behaviors in the school setting.*

Confidentiality	*Any potential loss of confidentiality will be minimized by securing all data collected. The digital recording file will password protected and will be deleted once a transcription is produced. The transcript and all additional data will be stored on a password protected computer. Consent forms will be stored in a locked office.* *If we write a report or article about this research project, your identity will be protected to the maximum extent possible. Your name, the names of your students, and the name of your program will not be identified and your specific responses will not be directly attributed to you. Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.*
Right to Withdraw and Questions	*Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.* *If you decide to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator:* ***Amy Schachtner-Appel, MS, RD*** ***University of Maryland***
Participant Rights	*If you have questions about your rights as a research participant or wish to report a research-related injury, please contact:* University of Maryland College Park Institutional Review Board Office 1204 Marie Mount Hall College Park, Maryland, 20742 E-mail: irb@umd.edu Telephone: 301-405-0678 *This research has been reviewed according to the*

	University of Maryland, College Park IRB procedures for research involving human subjects.	
Statement of Consent	*Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction and you voluntarily agree to participate in this research study. You will receive a copy of this signed consent form.* *If you agree to participate, please sign your name below.*	
Signature and Date	**NAME OF PARTICIPANT** **[Please Print]**	
	SIGNATURE OF PARTICIPANT	
	DATE	

Appendix 5.2: Recruitment Letter for Focus Group Participants

Dear Parent or Guardian,

My name is Amy Schachtner-Appel and I am a doctoral candidate at the University of Maryland. I am conducting a study to understand causes of food waste in the Caroline County public elementary schools. You are receiving this letter to ask your permission for your child to participate in a focus group as part of this study.

I will be holding focus groups with 3rd-5th grade students at your child's school. Each will last one hour and will take place during the school day on **[date]**.

If your child participates, he or she will take part in a group conversation where we will discuss ideas that elementary students have about food waste and nutrition. The conversation portion will take no more than 45 minutes. After that, we will spend about 10 minutes completing a survey to understand if it is of an appropriate reading level for your child's age group. We will not collect any identifying information from the children who participate beyond their first names, age, and grade level. If your child participates, he or she will be given a small reward as a thank you for volunteering his or her time.
If you give permission for your child to participate in a focus group, please read and sign the attached consent form and return it with this letter to your child's teacher **by [date].** I will then collect the forms from him/her.

Thank you very much for your time! Please contact me if you have any questions or concerns about this study.

Sincerely,

Amy Schachtner-Appel

[contact information removed]

Please provide a phone number or email address if you would like to receive a reminder before the focus group:

_____

Appendix 5.3: Parental Consent for Focus Group Participants

CONSENT TO PARTICIPATE

Project Title	*Formative Research to Design a Theory-driven Intervention to Reduce Food Waste in Elementary Schools*
Purpose of the Study	*This research is being conducted by **Amy Schachtner-Appel** at the University of Maryland, College Park. We are inviting your child to participate in this research project because your child is a 3rd-5th grade student in a Caroline County public elementary school. The purpose of this research project is to understand food waste behaviors in 3rd-5th grade children who attend the Caroline County Public School System. We plan to use the information that we obtain from this study to design a school-based program to reduce food waste in elementary schools.*
Procedures	*The procedures involve participating in a 60-minute focus group of 8-10 children. We would like to talk with your child about his or her opinions of the food served in the school cafeteria as part of a small group. The purpose of this study is to understand which foods are thrown away in during lunch, reasons why those foods are thrown away, and what strategies might be helpful to encourage students to throw away less food while consuming a healthy diet. We plan to ask 60 children between the grades of 3 and 5 in three Caroline County elementary schools to participate in our research.* *If you agree, your child will participate in a focus group of 8-10 children and a moderator to talk about their opinions of foods served in the school cafeteria. The focus group will take place at your child's school during school hours and is expected to take one hour to complete. We would like to audiotape the interview, but taping is not required for your child to be part of the study.* *Following the group discussion, we will ask the children who participate to complete a survey that we are*

	considering for use in a future study. Completing the survey is expected to take 10-15 minutes and it asks questions regarding student attitudes and beliefs related to food waste. We are asking children to complete the survey as part of this study so we can understand if the surveys are understandable and age-appropriate for 3rd-5th grade students. Completing the questionnaires is not required for your child to be part of the study. *As an incentive for volunteering their time, we are offering each child a small reward valued at approximately $10, such as an insulated lunch bag or similar item. This reward will not be withheld if your child decides to stop participating in the study at any time.*
Potential Risks and Discomforts	*There may be some risks from participating in this research study. Although the topics that will be covered in the focus group are not sensitive, speaking in a group setting may be difficult for your child. The moderator will encourage all children who are comfortable to participate, but will not force anyone to speak if he or she does not want to. All students will be reminded that participating is voluntary.* *Similarly, while we do not believe that the content of the survey is sensitive, your child may feel uncomfortable answering some or all of the questions. We will encourage children to privately tell us if they do not want to answer any or all of the questions and will remind them that participation in this portion of the study is also voluntary.*
Potential Benefits	*There are no direct benefits from participating in this research. However, possible benefits include the possibility that students may experience feeling a constructive sense of involvement in their school community. We hope that, in the future, other people might benefit from this study through improved understanding of children's food waste behavior at school meals.*

Confidentiality	*Any potential loss of confidentiality will be minimized by storing data in a secure location in a locked filing cabinet and on a password protected computer. The audio recording of the focus group will be stored in a password protected file until a transcript is created; after that, the recording will be deleted.* *If we write a report or article about this research project, your child's identity will be protected to the maximum extent possible. Possible exceptions to confidentiality include cases of suspected child abuse or neglect. If there is reason to believe that a child has been abused or neglected, we are required by law to report this suspicion to the proper authorities. Your child's information may be shared with representatives of the University of Maryland, College Park or governmental authorities if your child or someone else is in danger or if we are required to do so by law.*
Compensation	*Your child will receive a small incentive for participating, such as an insulated lunch bag or similar item, valued at $10 or less. You will be responsible for any taxes assessed on the compensation.* *If your child will earn $100 or more as a research participant in this study, you must provide your name, address and SSN to receive compensation.* *If your child does not earn over $100 only your name and address will be collected to receive compensation.*
Right to Withdraw and Questions	*Your child's participation in this research is completely voluntary. Your child may choose not to take part at all. If you decide to participate in this research, your child may stop participating at any time. If your child decides not to participate in this study or stops participating at any time, your child will not be penalized or lose any benefits to which you otherwise qualify.* *If your child decides to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator:*

	Amy Schachtner-Appel, MS, RD ***University of Maryland***	
Participant Rights	*If you have questions about your rights as a research participant or wish to report a research-related injury, please contact:* University of Maryland College Park Institutional Review Board Office 1204 Marie Mount Hall College Park, Maryland, 20742 E-mail: irb@umd.edu Telephone: 301-405-0678 *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*	
Statement of Consent	*Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction and you voluntarily agree to have your child participate in this research study. You will receive a copy of this signed consent form.* *If you agree to participate, please sign your name below.*	
Signature and Date	**NAME OF MINOR PARTICIPANT** **[Please Print]**	
	NAME OF PARENT **[Please Print]**	
	SIGNATURE OF PARENT	
	DATE	

Appendix 5.4: Assent Script for Focus Group Participants

Thank you all for coming today! I'd like to start by briefly introducing myself. My name is Amy and I am a graduate student at the University of Maryland. I am interested in studying food waste in your cafeteria – specifically, I'd like to find out what foods are thrown away at lunchtime and why, and then hopefully we can talk about some ideas that can help students throw away less food.

We are here for what's called a focus group – this is for us to brainstorm ideas as a group, so I'd like to ask you to please share your ideas and listen to the ideas that others share as well. Anything you have to say will be helpful for me. You should also know that everything we talk about is confidential, which means that I won't tell anyone your names or anything that you said to people that are not working on this project. Your participation today is completely voluntary, which means that if you decide that you do not want to participate any more, you are free to leave the conversation. Does everyone want to continue?

[Continue if there are no objections.]

So that I can remember everything that we talk about, would it be OK if I record our conversation?

[If no one objects, start the recorder; otherwise, plan to take notes and reiterate that all information is confidential. If recording, explain that the tape will be deleted after it is transcribed.]

Appendix 5.5: Recruitment Letter & Application for Student Leaders

January 7, 2019

Hello fifth graders and parents!

My name is Amy and I am a graduate student from the University of Maryland. I have received permission from the Caroline County Public School System and the University of Maryland to work on a research study about food and nutrition in your school called ***Farm to Tray, Tray to Farm***. As part of this project, I am looking for a group of 5th grade students to form a new club. In this club, we will spend a lot of our time playing games and doing activities so that we can understand where our food comes from and how it helps us grow, learn, and have energy to play. Then, we will come up with fun ways for you to teach what you learned to the rest of your school.

Do you think you might enjoy being part of this club? We would love to have you participate! This club might be fun for you if:

- You are curious about health, nutrition, and the environment
- You want to help your school be a healthier place for everyone
- You think it would be fun to teach what you learn to your classmates
- You want to be a good role model for younger students
- You are able to come to school early once a week during the winter and spring

We will meet on Tuesdays at 8:00 am before school starting at the end of January and ending in May. If you are interested, please talk about it with your parents and then complete and return the attached application to your teacher by January 14th. Please also

have your parents sign and return the attached consent form. If we receive applications from more students than we have room for, we may put some students on a waiting list – so please apply early!

If you or your parents have any questions, they can contact me at [email] or [phone].

Thank you! I look forward to meeting you!

Sincerely,

Amy Schachtner-Appel

Farm to Tray, Tray to Farm

Veggie Leaders Club

What is your name? _____

How old are you? _____

Who is your teacher? _____

Why do you want to join this club?

What is your favorite vegetable and why?

Please describe a creative way to teach a friend about a new healthy idea.

Can you come to school at 8 am on Tuesdays?

___ Yes
___ No

Thank you for your application and interest in our club! Please sign your name and give this to your parent to review and sign. Please return this application to your teacher by

January 14th.

Student's signature: _____

Parent's signature: _____

Date: _____

Appendix 5.6: Parental Consent for Student Leaders

CONSENT TO PARTICIPATE

Project Title	*A Pilot Intervention to Increase Vegetable Intake and Reduce Food Waste Through Mindfulness and Food System Education*
Purpose of the Study	*This research is being conducted by **Amy Schachtner-Appel** at the University of Maryland, College Park. We are inviting your child to participate in a component of this research project because your child is a 5th grade student at Greensboro Elementary School. The purpose of this research project is to create a school-wide intervention to increase vegetable intake and reduce waste of vegetables at lunch. Your child is invited to participate in a club that will function as a student-led education and leadership group, where the participating children will learn about mindful eating and the food system and then disseminate what they have learned to their school.*
Procedures	*The club component of this study involves meeting with a group of approximately 10 students on Tuesday mornings from January through early May. We would like to meet with the students at 8 am and spend about 45 minutes participating in activities to learn about where the food we eat comes from and how healthy food supports us through our lives. We will also encourage the students to come up with creative ideas to inform the rest of the school about what they have learned – for example, by making signs for the cafeteria or teaching brief lessons to classes of younger students.* *The procedures involve participating in 45-minute interactive education sessions over a period of 16 weeks. On odd weeks we will cover a lesson as a group and on even weeks we will play ways to spread what the children have learned to the rest of the school. The club meetings will conclude before the academic day begins and will not impact your child's attendance in*

	home room or presence during school breakfast. We may provide small snacks during the club as a taste test of healthy foods served in the cafeteria but will notify you at least a week ahead of time to let you know what foods will be served, ask about any allergies your child has, and request your permission for your child to participate. The overall purpose of this study is to encourage all elementary school students to eat more vegetables at lunch and create less food waste. The purpose of the club is to encourage a small group of interested students to develop the knowledge and leadership skills necessary to serve as healthy role models in their school and to teach their peers about these concepts in a fun and exciting way. *If you agree, your child will participate in weekly club meetings on Tuesday mornings and occasional activities during the school day, which will be arranged ahead of time to similarly request your permission. The meetings are planned for January 22nd through May 6th at 8 am and will require your child to be dropped off at school early on those days. Occasional absences will not affect your child's ability to participate, although we are hoping to enroll a group of excited and motivated students who will be able to participate consistently. Participating is completely voluntary and your child is free to decide to stop participating at any point during the study. If need, we may adjust the schedule if there are closures or late openings due to weather and will notify you as appropriate.* *As part of this research study, we will also ask your child to participate in an interview at the end of the study. The interview will last approximately 10-20 minutes and we will ask your child to provide feedback about his or her experience in the club, specifically which aspects they enjoyed and which ones they would like to change. This will help us to improve the program. Your child's ability to participate in the club is not dependent on agreeing to complete the interview. The interview will be recorded if you and your child agree. If you or your child do not wish for the interview to be*

	recorded, your child can still participate and the researcher will take notes.
Potential Risks and Discomforts	*There may be some risks from participating in this research study. Although the topics that will be covered in the club are not sensitive, speaking in a group setting may be difficult for your child. The researcher leading the club will encourage all children who are comfortable to participate but will not force anyone to speak if he or she does not want to. All students will be reminded that participating is voluntary.* *Similarly, while we do not believe that the content of the interview is sensitive, your child may feel uncomfortable answering some or all of the questions. We will encourage children to tell us if they do not want to answer any or all of the questions and will remind them that participation in this portion of the study is also voluntary.*
Potential Benefits	*There are no direct benefits from participating in this research. However, possible benefits include the possibility that students may experience feeling a constructive sense of involvement in their school community by acting as a healthy role model and student leader. We hope that this study will be effective in increasing children's intake of vegetables at lunch and reduce the amount of food waste produced, thereby improving the nutritional intake of the student body and reducing the school's impact on the environment.*
Confidentiality	*Any potential loss of confidentiality will be minimized by storing data in a secure location in a locked filing cabinet and on a password protected computer. The audio recording of the interview will be stored in a password protected file until a transcript is created; after that, the recording will be deleted.* *If we write a report or article about this research project, your child's identity will be protected to the maximum extent possible. Possible exceptions to confidentiality include cases of suspected child abuse or neglect. If there is reason to believe that a child has been abused or neglected, we are required by law to report this suspicion to the proper authorities. Your child's information may be shared with representatives of the University of Maryland, College Park or governmental*

	authorities if your child or someone else is in danger or if we are required to do so by law.
Compensation	*Your child will receive a small incentive for participating, such as a club branded t-shirt or similar item, valued at $10 or less. You will be responsible for any taxes assessed on the compensation.* *If your child will earn $100 or more as a research participant in this study, you must provide your name, address and SSN to receive compensation. If your child does not earn over $100 only your name and address will be collected to receive compensation.*
Right to Withdraw and Questions	*Your child's participation in this research is completely voluntary. Your child may choose not to take part at all. If you decide to participate in this research, your child may stop participating at any time. If your child decides not to participate in this study or stops participating at any time, your child will not be penalized or lose any benefits to which you otherwise qualify.* *If your child decides to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator:* ***Amy Schachtner-Appel, MS, RD*** ***University of Maryland***
Participant Rights	*If you have questions about your rights as a research participant or wish to report a research-related injury, please contact:* University of Maryland College Park Institutional Review Board Office 1204 Marie Mount Hall College Park, Maryland, 20742 E-mail: irb@umd.edu Telephone: 301-405-0678 *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*

<table>
<tr><td>Statement of Consent</td><td colspan="2">Your signature indicates that you are at least 18 years of age; you have read this consent form or have had it read to you; your questions have been answered to your satisfaction and you voluntarily agree to have your child participate in this research study. You will receive a copy of this signed consent form.

If you agree to participate, please sign your name below.</td></tr>
<tr><td rowspan="3">Signature and Date</td><td>NAME OF PARTICIPANT
[Please Print]</td><td></td></tr>
<tr><td>SIGNATURE OF PARTICIPANT</td><td></td></tr>
<tr><td>DATE</td><td></td></tr>
<tr><td rowspan="3">Consent for Audio Recording</td><td colspan="2">Please indicate below whether or not you consent to your child’s interview at the end of the study being audio recorded. You do not need to provide consent for audio recording for your child to participate in the study; if you do not want your child’s interview to be recorded, the researcher will take notes.</td></tr>
<tr><td>☐</td><td>I consent to having my child’s interview audio recorded.</td></tr>
<tr><td>☐</td><td>I <u>do not</u> consent to having my child’s interview audio recorded.</td></tr>
</table>

Appendix 5.7 Assent Script for Student Leaders

Assent Script for Student Leaders

Thank you all for coming to our meeting this morning! I'd like to start by briefly introducing myself. My name is Amy and I am a graduate student at the University of Maryland. I am working on a project in your school about the food that kids your age throw away – specifically, I am trying to encourage kids to eat more vegetables and throw away less food in the cafeteria.

We are here to start a club and I'm considering you all to be my helpers in this project. We'll meet here once a week until the beginning of May and learn about food and the environment, and to put together ways for you to teach the rest of your school about what you learn. I want this to be fun for you all, so we'll play games and do a lot of activities – and any ideas that you have to teach to your classmates in fun and interesting ways will be really helpful for us.

You should know that your participation today and for the rest of the time that we meet is completely voluntary, which means that if you decide that you do not want to participate any more, you don't have to. If you decide that you don't want to participate in the middle of one of our meetings, we will ask you to stay until the end or to sit in the office until school starts so that your parents know you are somewhere safe. Does everyone want to continue?

[Continue with the first lesson if there are no objections.]

Appendix 5.8: Pilot Project Data Collection Announcement

January 21, 2019

Hello students and parents!

My name is Amy and I am a graduate student from the University of Maryland. I have received permission from the Caroline County Public School System and the University of Maryland to work on a study about food and nutrition in your school called ***Farm to Tray, Tray to Farm***. As part of this project, I will be collecting information about what students eat and throw away during lunch in the cafeteria.

To do this, I would like to take photographs of lunch trays of students who eat lunch provided by the cafeteria. If you/your child agree to participate, I will take a picture of his/her tray before and after eating, and I will ask your child to answer a couple questions about how hungry or full he/she felt before and after lunch. This process should only take a few seconds before and after your child eats and should not detract from the amount of time he or she has to eat. Only lunch trays will be visible in the photographs – your child will not be identifiable in any way.

I will also ask students in 3rd, 4th, and 5th grade to complete a brief survey about their thoughts and opinions about food and nutrition. The survey should take 5-10 minutes to complete and your child's teacher will distribute the surveys when the class is not busy. Your child does not have to eat the school lunch to participate in the survey. Both of these activities are completely voluntary, and your child will not receive any penalty if he or she wishes not to participate. Please contact me at [email] or [phone] if you have any questions, concerns, or you do not want your child to participate in this

research study. I will make an announcement on the day(s) that we will be conducting this research to remind students that their participation is voluntary, so your child will have another opportunity to opt-out at that time. There is no direct benefit for participating, but I hope that this research will advance our understanding about dietary behaviors of children.

Thank you very much for your time!

Sincerely,

Amy Schachtner-Appel

Appendix 5.9: Assent Script for Pilot Project Data Collection Participants

Script to be read to students in classrooms of teachers who agree to participate before data collection

Hello, everyone! My name is Amy and I am a graduate student at the University of Maryland. I am working on a project in your school about the food that kids eat and throw away during lunchtime in the cafeteria.

To do this, I'd like to collect some information from anyone who is willing. If you eat lunch that the cafeteria serves, I'd like to take a picture of your tray before and after you eat. Your teacher will give you an ID card to bring with you to lunch and then you'll see me in the cafeteria after you pick up your tray. If you are OK with it, I'll take a quick picture of your food when you pick it up, and then again after you are done eating. I will also give you a piece of paper with a couple of short questions on it and a pencil, and we'd like you to answer it at some point during lunch. The whole process will be really quick and you won't be in the pictures – only your tray will be visible. If you'd rather not be part of this, you can just walk past me when you see me with the camera. This is voluntary, so it's up to you to decide if you'd like to participate or not.

If you are in 3rd, 4th, or 5th grade, I also have a survey that I'd like you to fill out if you are willing. Your teacher will hand these out to you at some point during the week when your class isn't busy. The survey will only take 5 or 10 minutes for you to fill out, and you don't have to answer anything you don't want to. You can fill out this survey even if you don't eat lunch at school. It's not a test and there are no right or wrong

answers, I'm just interested in your opinions. Again, this is voluntary, so you don't have to participate if you don't want to.

Does anyone have any questions?

BIBLIOGRAPHY

1. Byker Shanks C, Banna J, Serrano EL. Food waste in the National School Lunch Program 1978-2015: A systematic review. *J Acad Nutr Diet*. 2017;117(11):1792-1807. doi:10.1016/j.jand.2017.06.008

2. US Department of Agriculture Food and Nutrition Service. Nutrition Standards for School Meals. https://www.fns.usda.gov/school-meals/nutrition-standards-school-meals. Published November 7, 2017. Accessed March 1, 2018.

3. US Department of Agriculture (USDA), Food and Nutrition Service. School Nutrition and Meal Cost Study. https://www.fns.usda.gov/school-nutrition-and-meal-cost-study. Published April 2019. Accessed September 18, 2019.

4. Anonymous, Briggs M, Safaii S, Beall DL. Position of the American Dietetic Association, Society for Nutrition Education, and American School Food Service Association-Nutrition services: An essential component of comprehensive school health programs. *Am Diet Assoc J Am Diet Assoc Chic*. 2003;103(4):505-514.

5. Au LE, Rosen NJ, Fenton K, Hecht K, Ritchie LD. Eating school lunch is associated with higher diet quality among elementary school students. *J Acad Nutr Diet*. 2016;116(11):1817-1824. doi:10.1016/j.jand.2016.04.010

6. Buzby JC, Guthrie JF. *Plate Waste in School Nutrition Programs: Final Report to Congress (E-Fan-02-009).*; 2002. https://www.ers.usda.gov/webdocs/publications/43131/31216_efan02009.pdf?v=41423. Accessed March 1, 2018.

7. Briefel RR, Wilson A, Gleason PM. Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *J Am Diet Assoc*. 2009;109(2 Suppl):S79-90. doi:10.1016/j.jada.2008.10.064

8. USDA, FNS. USDA Announces Support for Smarter Lunchrooms. https://www.fns.usda.gov/pressrelease/2014/003714. Accessed September 23, 2019.

9. Smarter Lunchrooms Movement. Program Partnerships. https://www.smarterlunchrooms.org/about/program-partnerships. Accessed September 23, 2019.

10. Bark K, Byker-Shanks C, Stenberg M. Innovative strategies for creating Smarter Lunchrooms in Montana high schools. *J Nutr Educ Behav*. 2015;47(4):S113. doi:10.1016/j.jneb.2015.04.316

11. Hakim SM, Meissen G. Increasing consumption of fruits and vegetables in the school cafeteria: The influence of active choice. *J Health Care Poor Underserved*. 2013;24(2):145-157. doi:10.1353/hpu.2013.0109

12. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. *J Hum Nutr Diet*. 2005;18(6):431-443. doi:10.1111/j.1365-277X.2005.00648.x

13. Dill A, Williams K. Creating Wisconsin Smarter Lunchrooms to increase student selection of healthful foods. *J Nutr Educ Behav*. 2016;48(7):S136-S137. doi:10.1016/j.jneb.2016.04.301

14. Greene KN, Gabrielyan G, Just DR, Wansink B. Fruit-promoting Smarter Lunchrooms interventions: Results from a cluster RCT. *Am J Prev Med*. 2017;52(4):451-458. doi:10.1016/j.amepre.2016.12.015

15. Guthrie JF, Buzby JC. Several strategies may lower plate waste in school feeding programs. *FoodReview*. 2002;25(2):36-42.

16. Sobal J, Kettel Khan L, Bisogni C. A conceptual model of the food and nutrition system. *Soc Sci Med*. 1998;47(7):853-863. doi:10.1016/S0277-9536(98)00104-X

17. Neff RA. *Toward a Healthy Sustainable Food System*. American Public Health Association; 2007. https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/29/12/34/toward-a-healthy-sustainable-food-system. Accessed September 27, 2019.

18. Story M, Hamm MW, Wallinga D. Food systems and public health: Linkages to achieve healthier diets and healthier communities. *J Hunger Environ Nutr*. 2009;4(3-4):219-224. doi:10.1080/19320240903351463

19. Buzby JC, Wells HF, Hyman J. The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States, EIB-121. February 2014. www.ers.usda.gov/publications/eib-economic-information-bulletin/eib-xxx.aspx.

20. Venkat K. The climate change and economic impacts of food waste in the United States. *Int J Food Syst Dyn*. 2011;2(4):431-446.

21. Hall KD, Guo J, Dore M, Chow CC. The progressive increase of food waste in America and its environmental impact. *PLoS ONE*. 2009;4(11):e7940. doi:10.1371/journal.pone.0007940

22. Neff RA, Spiker ML, Truant PL. Wasted food: US consumer's reported awareness, attitudes, and behaviors. *PLoS ONE*. 2015;10(6). doi:10.1371/journal.pone.0127881

23. Spiker ML, Hiza HAB, Siddiqi SM, Neff RA. Wasted food, wasted nutrients: Nutrient loss from wasted food in the United States and comparison to gaps in dietary intake. *J Acad Nutr Diet*. 2017;117(7):1031-1040.e22. doi:10.1016/j.jand.2017.03.015

24. Blondin SA., Djang HC, Metayer N, Anzman-Frasca S, Economos CD. "It"s just so much waste.' A qualitative investigation of food waste in a universal free School Breakfast Program. *Public Health Nutr*. 2014;18(9):1565-1577. doi:10.1017/S1368980014002948

25. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. 2015.

26. Munesue Y, Masui T, Fushima T. The effects of reducing food losses and food waste on global food insecurity, natural resources, and greenhouse gas emissions. *Environ Econ Policy Stud*. 2015;17:43-77.

27. US EPA, OSWER. United States 2030 Food Loss and Waste Reduction Goal. US EPA. https://www.epa.gov/sustainable-management-food/united-states-2030-food-loss-and-waste-reduction-goal. Published April 14, 2016. Accessed September 26, 2017.

28. Muth MK, Birney C, Cuéllar A, et al. A systems approach to assessing environmental and economic effects of food loss and waste interventions in the United States. *Sci Total Environ*. 2019;685:1240-1254. doi:10.1016/j.scitotenv.2019.06.230

29. Kantor LS, Lipton K, Manchester A, Oliveira V. Estimating and addressing America's food losses. *Food Rev Mag Food Econ*. 1997;20(1). https://econpapers.repec.org/article/agsuersfr/234453.htm.

30. USDA, OCE. U.S. Food Waste Challenge: Resources Recovery/Donations. https://www.usda.gov/oce/foodwaste/resources/donations.htm. Accessed October 29, 2017.

31. Cohen JFW, Richardson S, Parker E, Catalano PJ, Rimm EB. Impact of the new US Department of Agriculture school meal standards on food selection, consumption, and waste. *Am J Prev Med*. 2014;46(4):388-394.

32. Cohen JFW, Richardson S, Austin SB, Economos CD, Rimm EB. School lunch waste among middle school students: Nutrients consumed and costs. *Am J Prev Med*. 2013;44(2):114-121.

33. Byker CJ, Farris AR, Marcenelle M, Davis GC, Serrano EL. Food waste in a school nutrition program after implementation of new lunch program guidelines. *J Nutr Educ Behav*. 2014;46(5):406-411.

34. Gase LN, McCarthy WJ, Robles B, Kuo T. Student receptivity to new school meal offerings: Assessing fruit and vegetable waste among middle school students in the Los Angeles Unified School District. *Prev Med*. 2014;67:528-533.

35. Smith SL, Cunningham-Sabo L. Food choice, plate waste and nutrient intake of elementary- and middle-school students participating in the US National School Lunch Program. *Public Health Nutr*. 2013;17(6):1255-1263. doi:10.1017/S1368980013001894

36. Schwartz MB, Henderson KE, Read M, Danna N, Ickovics JR. New school meal regulations increase fruit consumption and do not increase total plate waste. *Child Obes*. 2015;11(3):242-247. doi:10.1089/chi.2015.0019

37. Graham-Rowe E, Jessop DC, Sparks P. Identifying motivations and barriers to minimising household food waste. *Resour Conserv Recycl*. 2014;84:15-23.

38. Zhao C, Panizza C, Fox K, et al. Plate waste in school lunch: Barriers, motivators, and perspectives of SNAP-eligible early adolescents in the US. *J Nutr Educ Behav*. 2019;51(8):967-975. doi:10.1016/j.jneb.2019.05.590

39. Diep CS, Chen T-A, Davies VF, Baranowski JC, Baranowski T. Influence of behavioral theory on fruit and vegetable intervention effectiveness among children: A meta-analysis. *J Nutr Educ Behav*. 2014;46:506-546.

40. Bandura A. Health promotion from the perspective of social cognitive theory. *Psychol Health*. 1998;13(4):623-649. doi:10.1080/08870449808407422

41. Bandura A. Health Promotion by Social Cognitive Means. *Health Educ Behav*. 2004;31(2):143-164. doi:10.1177/1090198104263660

42. Hankonen N, Absetz P, Kinnunen M, Haukkala A, Jallinoja P. Toward identifying a broader range of social cognitive determinants of dietary intentions and behaviors. *Appl Psychol Health Well-Being*. 2013;5(1):118-135. doi:10.1111/j.1758-0854.2012.01081.x

43. Bandura A. *Social Foundations of Thought & Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall; 1986.

44. Reynolds KD, Hinton AW, Shewchuk RM, Hickey CA. Social cognitive model of fruit and vegetable consumption in elementary school children. *J Nutr Educ*. 1999;31(1):23-30.

45. Rinderknecht K, Smith C. Social cognitive theory in an after-school nutrition intervention for urban Native American youth. *J Nutr Educ Behav*. 2004;2004(36):298-304.

46. Berlin L, Norris K, Kolodinsky JM, Nelson A. The role of social cognitive theory in farm-to-school-related activities: Implications for child nutrition. *J Sch Health*. 2013;83:589-595.

47. Roche E, Conner D, Kolodinsky JM, Buckwalter E, Berlin L, Powers A. Social cognitive theory as a framework for considering farm to school programming. *Child Obes*. 2012;8(4):357-363. doi:10.1089/chi.2012.0035

48. Dewar DL, Lubans DR, Plotnikoff RC, Morgan PJ. Development and evaluation of social cognitive measures related to adolescent dietary behaviors. *Int J Behav Nutr Phys Act*. 2012;9:36. doi:10.1186/1479-5868-9-36

49. McClain AD, Chappuis C, Nguyen-Rodriguez ST, Yaroch AL, Spruijt-Metz D. Psychosocial correlates of eating behavior in children and adolescents: a review. *Int J Behav Nutr Phys Act*. 2009;6:54. doi:10.1186/1479-5868-6-54

50. Bissonnette MM, Contento IR. Adolescents' perspectives and food choice behaviors in terms of the environmental impacts of food production practices: Application of a psychosocial model. *J Nutr Educ*. 2001;33(2):72-82. doi:10.1016/S1499-4046(06)60170-X

51. Cerin E, Barnett A, Baranowski T. Testing theories of dietary behavior change in youth using the mediating variable model with intervention programs. *J Nutr Educ Behav*. 2009;41(5):309-318. doi:10.1016/j.jneb.2009.03.129

52. Harris JE, Gleason PM, Sheean PM, Boushey C, Beto JA, Bruemmer B. An introduction to qualitative research for food and nutrition professionals. *J Am Diet Assoc*. 2009;109(1):80-90. doi:10.1016/j.jada.2008.10.018

53. Daly J, Willis K, Small R, et al. A hierarchy of evidence for assessing qualitative health research. *J Clin Epidemiol*. 2007;60(1):43-49. doi:10.1016/j.jclinepi.2006.03.014

54. Kolb SM. Grounded theory and the constant comparative method: Valid research strategies for educators. *J Emerg Trends Educ Res Policy Stud*. 2012;3(1):83-86.

55. Carter SM, Little M. Justifying knowledge, justifying method, taking action: epistemologies, methodologies, and methods in qualitative research. *Qual Health Res*. 2007;17(10):1316-1328. doi:10.1177/1049732307306927

56. Johns Hopkins Center for a Livable Future. FoodSpan: Teaching the Food System from Farm to Fork. Johns Hopkins Bloomberg School of Public Health. http://www.foodspanlearning.org/about/. Accessed March 23, 2017.

57. Goleman D, Bennett L, Barlow Z. *Ecoliterate: How Educators Are Cultivating Emotional, Social, and Ecological Intelligence*. Jossey-Bass; 2012.

58. Wylie A, Pierson S, Goto K, Giampaoli J. Evaluation of a mindful eating intervention curriculum among elementary school children and their parents. *J Nutr Educ Behav*. 2018;50(2):206-208.e1. doi:10.1016/j.jneb.2017.09.017

59. Pierson S, Goto K, Giampaoli J, Wylie A, Seipel B. The development of a mindful-eating intervention program among third through fifth grade elementary school children and their parents. *Californian J Health Promot*. 2016;14(3):70-76.

60. Foodie U: Mindful Eating for Families – Healthy Food Choices in Schools. https://healthy-food-choices-in-schools.extension.org/foodie-u-mindful-eating-for-families/. Accessed September 28, 2019.

61. Costello HE, Schepers A. Feeding Minds, Fighting Hunger. *J Hunger Environ Nutr*. 2007;2(1):97-99. doi:10.1080/19320240802081062

62. Lietz P. Research into questionnaire design: A summary of the literature. *Int J Mark Res*. 2010;52(2):249-272. doi:10.2501/S147078530920120X

63. Lane HG, Deitch R, Wang Y, et al. "Wellness Champions for Change," a multi-level intervention to improve school-level implementation of local wellness policies: Study protocol for a cluster randomized trial. *Contemp Clin Trials*. 2018;75:29-39. doi:10.1016/j.cct.2018.10.008

64. Campbell K, Lane H, Deitch R, Turner L, Hager E. *Observational School Environment Checklist: Comprehensive Manual*. University of Maryland School of Medicine; 2018.

65. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health*. 1999;89(9):1322-1327. doi:10.2105/AJPH.89.9.1322

66. Jones NR, Jones A, van Sluijs EM, Panter J, Harrison F, Griffin SJ. School environments and physical activity: The development and testing of an audit tool. *Health Place*. 2010;16(5):776-783. doi:10.1016/j.healthplace.2010.04.002

67. Kenney EL, Gortmaker SL, Cohen JFW, Rimm EB, Cradock AL. Limited school drinking water access for youth. *J Adolesc Health*. 2016;59(1):24-29. doi:10.1016/j.jadohealth.2016.03.010

68. Thomas LN, Hill TF, Gaines A, Dollahite JS. Implementing Smarter Lunchrooms makeovers in New York state middle schools: an initial process evaluation. *Arch Public Health*. 2016;74(41). doi:10.1186/s13680-016-0153-9

69. Hanks AS, Wansink B, Just DR. Reliability and accuracy of real-time visualization techniques for measuring school cafeteria tray waste: Validating the quarter-waste method. *J Acad Nutr Diet*. 2014;114:470-474.

70. Martins ML, Cunha LM, Rodrigues SSP, Rocha A. Determination of plate waste in primary school lunches by weighing and visual estimation methods: A validation study. *Waste Manag*. 2014;34:1362-1368.

71. Swanson M. Digital photography as a tool to measure school cafeteria consumption. *J Sch Health*. 2008;78(8).

72. Taylor JC, Yon BA, Johnson RK. Reliability and validity of digital imaging as a measure of schoolchildren's fruit and vegetable consumption. *J Acad Nutr Diet*. 2014;114:1359-1366.

73. Williamson DA, Allen R, Martin PD, Alfonso AJ, Gerald B, Hunt A. Comparison of digital photography to weighed and visual estimation of portion sizes. *J Am Diet Assoc*. 2003;103:1139-1145.

74. Comstock E, Pierre RS, Mackiernan Y. Measuring individual plate waste in school lunches. Visual estimation and children's ratings vs. actual weighing of plate waste. *J Am Diet Assoc*. 1981;79(3):290-296.

75. Navarro DA, Singer P, Leibovitz E, Krause I, Boaz M. Inter- and intra-rater reliability of digitally captured images of plate waste. *Nutr Diet*. 2014;71:284-288.

76. Martins ML, Rodrigues SSP, Cunha LM, Rocha A. Strategies to reduce plate waste in primary schools - experimental evaluation. *Public Health Nutr*. 2015;19(8):1517-1525.

77. Kim M-S, Jeon E-R, Hwang K-H, Jung L-H. Perception and Attitudes to Leftover Food at School Food Service -The Elementary School Students in Gwangju Area-. *J Korean Soc Food Sci Nutr*. 2011;40(1):137-147. doi:10.3746/jkfn.2011.40.1.137

78. EWWR Steering Committee. *European Week for Waste Reduction: EWWR Guide of Good Practice*.; 2012. https://www.ewwr.eu/docs/ewwr/EWWR_Guide_GP_EN_LD.pdf. Accessed October 7, 2019.

79. Persson Osowski C, Göranzon H, Fjellström C. Teachers' interaction with children in the school meal situation: the example of pedagogic meals in Sweden. *J Nutr Educ Behav*. 2013;45(5):420-427. doi:10.1016/j.jneb.2013.02.008

80. Cordingley F, Reeve S, Stephenson J. *Food Waste in Schools: Final Report*. Waste and Resource Action Programme; 2011. http://www.wrap.org.uk/sites/files/wrap/Food%20waste%20in%20schools%20full%20report%20.pdf. Accessed October 7, 2019.

81. Sharp V, Giorgi S, Wilson D. Delivery and impact of household waste prevention intervention campaigns (at the local level). *Waste Manag Res*. 2010;28:256-268.

82. Kallbekken S, Saelen H. "Nudging" hotel guests to reduce food waste as a win-win environmental measure. *Econ Lett*. 2013;119:325-327.

83. Whitehair KJ, Shanklin CW, Brannon LA. Written messages improve edible food waste behaviors in a university dining facility. *J Acad Nutr Diet*. 2013;113:63-69.

84. Williams H, Wikstrom F, Otterbring T, Lofgren M, Gustafsson A. Reasons for household food waste with special attention to packaging. *J Clean Prod*. 2012;24:141-148.

85. Wang D, Stewart D. The implementation and effectivenss of school-based nutrition promotion programmes using a health-promoting schools approach: a systematic review. *Public Health Nutr*. 2012;16(6):1082-1100. doi:10.1017/S1368980012003497

86. Radcliffe B, Ogden C, Welsh J, Carroll S, Coyne T, Craig P. The Queensland School Breakfast Project: a health promoting schools approach. *Nutr Diet*. 2005;62(1):33-40. doi:10.1111/j.1747-0080.2005.tb00007.x

87. McIsaac J-LD, Hernandez KJ, Kirk SFL, Curran JA. Interventions to Support System-level Implementation of Health Promoting Schools: A Scoping Review. *Int J Environ Res Public Health*. 2016;13(2). doi:10.3390/ijerph13020200

88. Freeman R, Bunting G. A child-to-child approach to promoting healthier snacking in primary school children: a randomized trial in Northern Ireland. *Health Educ*. 2003;103:17-27.

89. McVey G, Tweed S, Blackmore E. Healthy Schools-Healthy Kids: a controlled evaluation of a comprehensive universal eating disorder prevention program. *Body Image*. 2007;4:115-136.

90. Laureati M, Bergamaschi V, Pagliarini E. School-based intervention with children. Peer-modeling, reward and repeated exposure reduce food neophobia and increase liking of fruits and vegetables. *Appetite*. 2014;83:26-32. doi:10.1016/j.appet.2014.07.031

91. Lo E, Coles R, Humbert ML, Polowski J, Henry CJ, Whiting SJ. Beverage intake improvement by high school students in Saskatchewan, Canada. *Nutr Res N Y N*. 2008;28(3):144-150. doi:10.1016/j.nutres.2008.01.005

92. Story M, Lytle LA, Birnbaum AS, Perry CL. Peer-led, school-based nutrition education for young adolescents: feasibility and process evaluation of the TEENS study. *J Sch Health*. 2002;72(3):121-127.

93. Gutuskey L, McCaughtry N, Shen B, Centeio E, Garn A. The role and impact of student leadership on participants in a healthy eating and physical activity programme. *Health Educ J*. 2016;75(1):27-37. doi:10.1177/0017896914561878

94. Cohen JFW, Richardson SA, Cluggish SA, Parker E, Catalano PJ, Rimm EB. Effects of choice architecture and chef-enhanced meals on the selection and consumption of healthier school foods: a randomized clinical trial. *JAMA Pediatr*. 2015;169(5):431-437. doi:10.1001/jamapediatrics.2014.3805

95. Bontrager Yoder AB, Liebhart JL, McCarty DJ, et al. Farm to elementary school programming increases access to fruits and vegetables and increases their consumption among those with low intake. *J Nutr Educ Behav*. 2014;46(5):341-349.

96. Dirks AE, Orvis K. An evaluation of the junior master gardener program in third grade classrooms. *Hortitechnology*. 2005;15(3):443-447.

97. Barton AC, Koch PD, Contento IR, Hagiwara S. From global sustainability to inclusive education: Understanding urban children's ideas about the food system. *Int J Sci Educ*. 2005;27(10):1163-1183. doi:10.1080/09500690500069467

98. Contento IR, Koch PA, Lee H, Calabrese-Barton A. Adolescents demonstrate improvement in obesity risk behaviors following completion of Choice, Control, and Change, a curriculum addressing personal agency and autonomous motivation. *J Am Diet Assoc*. 2010;110(12):1830-1839. doi:10.1016/j.jada.2010.09.015

99. Brown KW, Ryan RM, Creswell JD. Mindfulness: Theoretical Foundations and Evidence for its Salutary Effects. *Psychol Inq*. 2007;18(4):211-237. doi:10.1080/10478400701598298

100. Fung TT, Long MW, Hung P, Cheung LWY. An expanded model for mindful eating for health promotion and sustainability: Issues and challenges for dietetics practice. *J Acad Nutr Diet*. 2016;116(7):1081-1086. doi:10.1016/j.jand.2016.03.013

101. Jordan CH, Wang W, Donatoni L, Meier BP. Mindful eating: Trait and state mindfulness predict healthier eating behavior. *Personal Individ Differ*. 2014;68:107-111. doi:10.1016/j.paid.2014.04.013

102. Harpin SB, Rossi A, Kim AK, Swanson LM. Behavioral impacts of a mindfulness pilot intervention for elementary school students. *Education*. 2016;137(2):149-156.

103. Food and Agriculture Organization of the United Nations. Sustainable Food Systems – Concept and Framework. 2018. http://www.fao.org/policy-support/resources/resources-details/en/c/1160811/. Accessed September 23, 2019.

104. Gaddis J, Coplen A. Reorganizing school lunch for a more just and sustainable food system in the US. *Fem Econ*. 2018;24(3):89-112.

105. Carlsson L, Williams P. New approaches to the health promoting school: Participation in sustainable food systems. *J Hunger Environ Nutr*. 2008;3(4). doi:http://dx.doi.org/10.1080/19320240802529243

106. Zoellner J, Harris JE. Mixed-methods research in nutrition and dietetics. *J Acad Nutr Diet*. 2017;117(5):683-697. doi:10.1016/j.jand.2017.01.018

107. United States Census Bureau. U.S. Census Bureau QuickFacts selected: Caroline County, Maryland. https://www.census.gov/quickfacts/fact/table/carolinecountymaryland/PST045216. Accessed September 27, 2017.

108. Maryland State Department of Education. Free and Reduced-Price Meal Statistics. http://www.marylandpublicschools.org/programs/Pages/School-Community-Nutrition/FreeReducedPriceMealStatistics.aspx. Published 2019. Accessed September 29, 2019.

109. National Center for Education Statistics. Search for Public Schools. https://nces.ed.gov/ccd/schoolsearch. Accessed September 29, 2019.

110. Probart C, McDonnell E, Hartman T, Weirich JE, Bailey-Davis L. Factors associated with the offering and sale of competitive foods and school lunch participation. *J Am Diet Assoc*. 2006;106(2):242-247. doi:10.1016/j.jada.2005.10.031

111. Ishdorj A, Higgins L. Children's food security and participation in the National School Lunch Program. *Appl Econ Finance*. 2015;2(1):119-128. doi:10.11114/aef.v2i1.655

112. Frerichs L, Brittin J, Sorensen D, et al. Influence of school architecture and design on healthy eating: A review of the evidence. *Am J Public Health*. 2015;105(4):e46-e57. doi:10.2105/AJPH.2014.302453

113. DeCosta P, Møller P, Frøst MB, Olsen A. Changing children's eating behaviour - A review of experimental research. *Appetite*. 2017;113:327-357. doi:10.1016/j.appet.2017.03.004

114. Economos CD, Folta SC, Goldberg J, et al. A community-based restaurant initiative to increase availability of healthy menu options in Somerville, Massachusetts: Shape Up Somerville. *Prev Chronic Dis*. 2009;6(3). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2722387/.

115. DeBar L, Schneider M, Ford E, et al. Social marketing-based communications to integrate and support the HEALTHY study intervention. *Int J Obes 2005*. 2009;33(Suppl 4):S52-S59. doi:10.1038/ijo.2009.117

116. USDA, OCE. U.S. Food Waste Challenge: K-12 Schools. https://www.usda.gov/oce/foodwaste/resources/K12_schools.html. Accessed August 27, 2019.

117. USDA Food and Nutrition Service. The Use of Share Tables in Child Nutrition Programs. June 2016. https://fns-prod.azureedge.net/sites/default/files/cn/SP41_CACFP13_SFSP15_2016os.pdf. Accessed August 27, 2019.

118. US Department of Agriculture (USDA), Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Legacy. http://www.ars.usda.gov/nutrientdata. Published April 2018. Accessed September 19, 2019.

119. Kelder S, Hoelscher DM, Barroso CS, Walker JL, Cribb P, Hu S. The CATCH Kids Club: a pilot after-school study for improving elementary students' nutrition and physical activity. *Public Health Nutr*. 2005;8(2):133-140. doi:10.1079/PHN2004678

120. US Environmental Protection Agency. A Guide to Conducting Student Food Waste Audits: A Resource for Schools. December 2017. https://www.epa.gov/sustainable-management-food/guide-conducting-student-food-waste-audits-resource-schools. Accessed September 30, 2019.

121. Ose S. Using Excel and Word to structure qualitative data. *J Appl Soc Sci*. 2016;10. doi:10.1177/1936724416664948

122. US Department of Agriculture (USDA), Food and Nutrition Service. Local School Wellness Policy. https://www.fns.usda.gov/tn/local-school-wellness-policy. Published March 30, 2016. Accessed September 25, 2019.

123. Kessler H. Simple interventions to improve healthy eating behaviors in the school cafeteria. *Nutr Rev*. 2016;74(3):198-209.

124. US EPA O. Sustainable Materials Management (SMM) Web Academy Webinar: Reducing and Recovering Wasted Food in Schools - Lessons from the Cafeteria Line. US EPA. https://www.epa.gov/smm/sustainable-materials-management-smm-web-academy-webinar-reducing-and-recovering-wasted-food. Published March 13, 2017. Accessed August 14, 2019.

125. Lowe C, Horne P, Tapper K, Bowdery M, Egerton C. Effects of peer modelling and rewards-based intervention to increase fruit and vegetable consumption in children. *Eur J Clin Nutr*. 2004;58:510-522.

126. State Education and Environment Roundtable. California Student Assessment Project Phase Two: The Effects of Environment-Based Education on Student Achievement. January 2005. http://www.seer.org/pages/research/CSAPII2005.pdf. Accessed August 27, 2019.

127. Hingle MD, O'Connor TM, Dave JM, Baranowski T. Parental involvement in interventions to improve child dietary intake: A systematic review. *Prev Med*. 2010;51(2):103-111. doi:10.1016/j.ypmed.2010.04.014

128. Cooke L. The importance of exposure for healthy eating in childhood: a review. *J Hum Nutr Diet*. 2007;20(4):294-301. doi:10.1111/j.1365-277X.2007.00804.x

129. Bahl S, Milne GR, Ross SM, Chan K. Mindfulness: A long-term solution for mindless eating by college students. *J Public Policy Mark*. 2013;32(2):173-184.

130. Ma HK. The moral development of the child: An integrated model. *Front Public Health*. 2013;1. doi:10.3389/fpubh.2013.00057

131. Carr EG, Dunlap G, Horner RH, et al. Positive behavior support: Evolution of an applied science. *J Posit Behav Interv*. 2002;4(1):4-16. doi:10.1177/109830070200400102

132. Kummu M, Moel H de, Porkka M, Siebert S, Varis O, Ward PJ. Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. *Sci Total Environ*. 2012;438:477-489.

133. Wilkie AC, Graunke RE, Cornejo C. Food waste auditing at three Florida schools. *Sustainability*. 2015;7(2):1370-1387. doi:10.3390/su7021370

134. Monteiro CA, Cannon G, Moubarac J-C, Levy RB, Louzada MLC, Jaime PC. The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutr*. 2018;21(1):5-17. doi:10.1017/S1368980017000234

135. Fram MS, Frongillo EA, Fishbein EM, Burke MP. Roles for schools and school social workers in improving child food security. *Child Sch*. 2014;36(4):231-239. doi:10.1093/cs/cdu018

136. Mansfield JL, Savaiano DA. Effect of school wellness policies and the Healthy, Hunger-Free Kids Act on food-consumption behaviors of students, 2006–2016: a systematic review. *Nutr Rev*. 2017;75(7):533-552. doi:https://doi.org/10.1093/nutrit/nux020

137. Terry-McElrath Y, O'Malley P, Johnson L. Potential impact of national school nutritional environment policies: Cross-sectional associations with US secondary student overweight/obesity, 2008-2012. *JAMA Pediatr*. 2015;169(1):75-85. doi:10.1001/jamapediatrics.2014.2048

138. Briefel RR, Crepinsek MK, Cabili C, Wilson A, Gleason PM. School food environments and practices affect dietary behaviors of US public school children. *J Am Diet Assoc*. 2009;109(2, Supplement):S91-S107. doi:10.1016/j.jada.2008.10.059

139. Scheer S, Safrit RD. Nurturing future leadership skills in five to eight year-old children through self-awareness activities. *J Leadersh Stud*. 2001;8(2):105-111.

140. Wassermann S. *Serious Players in the Primary Classroom: Empowering Children Through Active Learning Experiences*. Teachers College Press; 2000.

141. Derqui B, Fernandez V, Fayos T. Towards more sustainable food systems. Addressing food waste at school canteens. *Appetite*. 2018;129:1-11. doi:https://doi.org/10.1016/j.appet.2018.06.022

142. Niaki SF, Moore CE, Chen T-A, Weber Cullen K. Younger elementary school students waste more school lunch foods than older elementary school students. *J Acad Nutr Diet*. 2017;117(1):95-101. doi:10.1016/j.jand.2016.08.005

143. Oostindjer M, Aschemann-Witzel J, Wang Q, et al. Are school meals a viable and sustainable tool to improve the healthiness and sustainability of children´s diet and food consumption? A cross-national comparative perspective. *Crit Rev Food Sci Nutr*. 2017;57(18):3942-3958. doi:10.1080/10408398.2016.1197180

144. Corrado S, Caldeira C, Eriksson M, et al. Food waste accounting methodologies: Challenges, opportunities, and further advancements. *Glob Food Secur*. 2019;20:93-100. doi:10.1016/j.gfs.2019.01.002